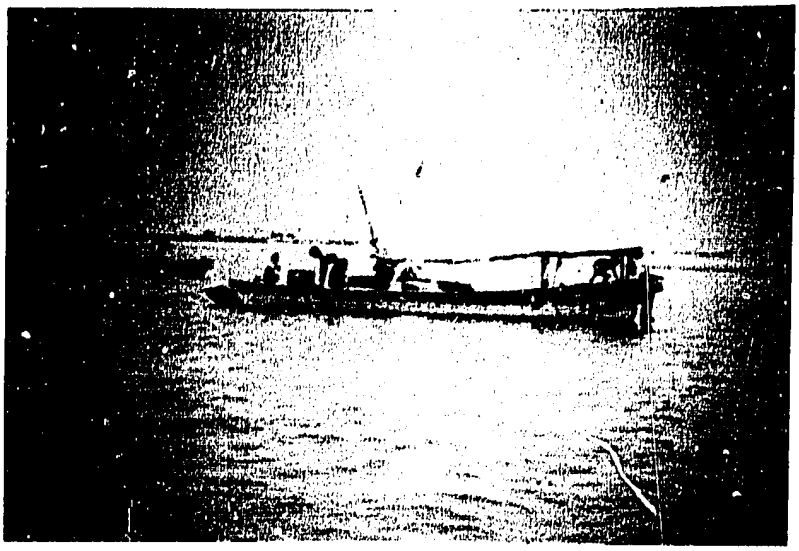

Eritrean fishers.

FINAL REPORT
ERITREA COASTAL AND MARINE RESOURCES ASSESSMENT AND PROJECT IDENTIFICATION

October 1993

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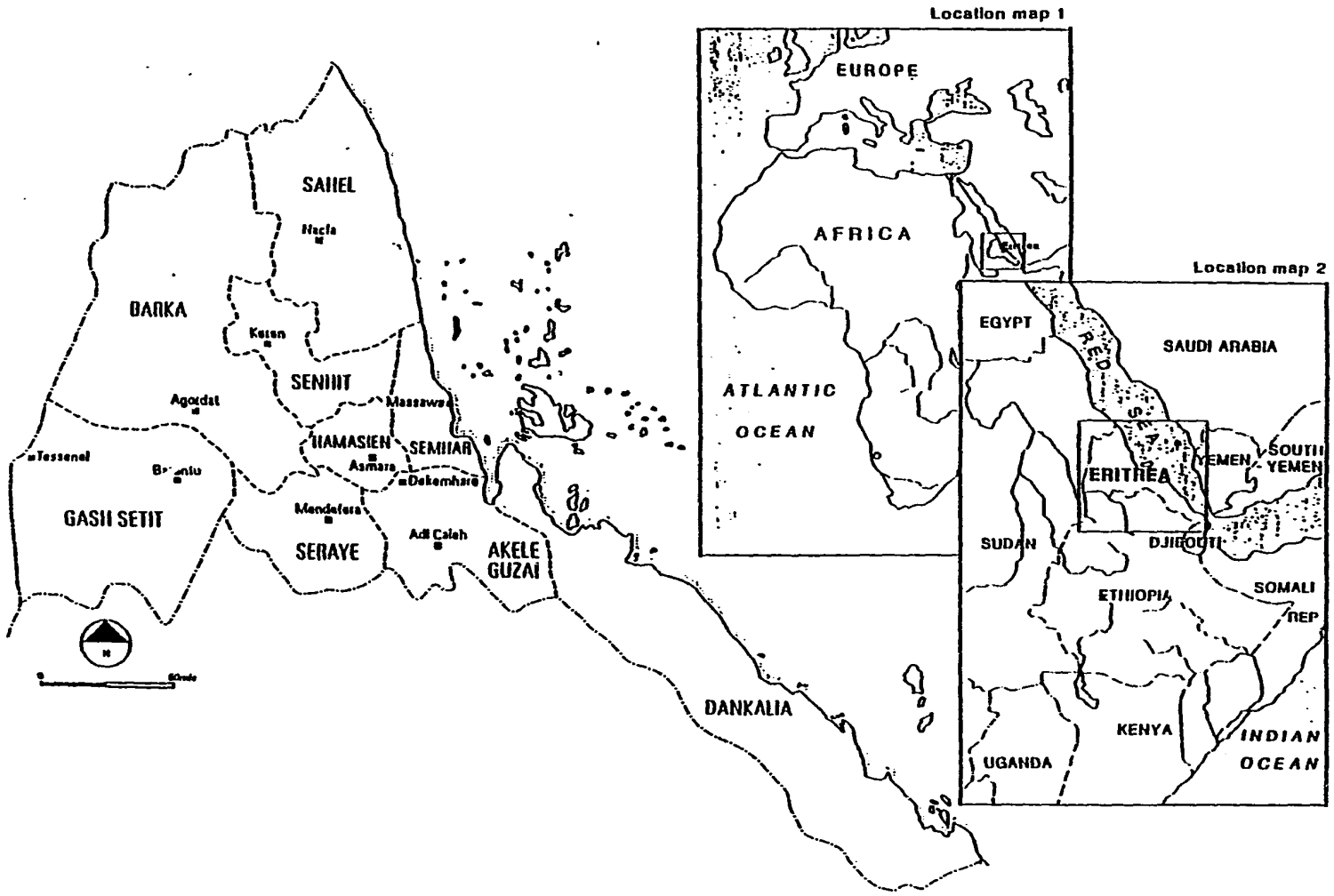
Figure i-1 Regions and main towns of Eritrea



*Adapted from: "Eritrea 1991 - A needs assessment study, final report." Centre for Development Studies, University of Leeds, August 1992. (Source: Reynolds *et al* 1993 a)

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GLOSSARY

CAS	Catch Assessment Survey
CMS	Control, Monitoring, and Surveillance
CPUE	Catch Per Unit Effort
CZM	Coastal Zone Management
DMRIF	Department of Marine resources and Inland Fisheries (Formerly the MMR)
EDA	Eritrea Diving Association
EEZ	Exclusive Economic Zone
EPLF	Eritrean Peoples Liberation Front
FAO	Food and Agricultural Organization of the United Nations
GDP	Gross Domestic Product
GEF	Global Environment Facility
GIS	Geographic Information System
GOE	Government of Eritrea
GPS	Global Positioning System
ICZM	Integrate Coastal Management
IMO	International Maritime Organization
LWF	Lutheran Worldwide Federation
MEPA	Marine Environment Protection Act
MMR	Ministry of Marine Resources
MSY	Maximum Sustainable Yield
mt	Metric Tons
NGO	Non Governmental Organization
PGE	Provisional Government of Eritrea
PSU	Primary Sampling Units
RDA	RDA International, Inc.
TAC	Total Allowable Catch
TCP	Technical Cooperation Programme
UNCDF	United Nations Capital Development Fund
UNDP	United Nations Development Programme
UNHCR	United Nations High Commission for Refugees
USAID	United States Agency for International Development

1.0 EXECUTIVE SUMMARY

This Eritrea Coastal and Marine Resources Assessment and Project Identification Report was prepared by RDA International, Inc. for USAID/Asmara under Indefinite Quantity Contract Delivery Order No. PDC-5517-I-15-0104-00. Based on the work of a four person team which visited Eritrea during 02-24 September 1993, the report provides an assessment of the current status of Eritrea's coastal and marine resources, evaluates the constraints on and opportunities for the sustainable development of these resources, develops a strategy for the sustainable development of these resources, evaluates gaps in current and proposed international donor assistance, and identifies and presents the design of one large long-term and several small short-term but high pay-off projects that require international donor assistance.

Eritrea became the world's newest country in May 1993. A country of approximately 3.2 million people, Eritrea is strategically located on the Red Sea, having a 1,155 km coastline extending from Sudan to Djibouti. With a per capita GDP estimated at between US$70 and US$150, Eritrea is among the poorest countries in the world. Eritrea's economy was devastated by the war for independence and the economic mismanagement of the previous regime. Recent droughts have exacerbated the economic problems. Eritrea is faced with the difficult challenges of simultaneously needing to create a new government, to establish new institutions, to reconstruct a war-torn economy, and to begin the process of economic development. To face these challenges, Eritrea is blessed with an absence of entrenched government bureaucracy and an abundance of deserved self confidence and optimism about the future.

Eritrea's marine and coastal resources are among its most valuable assets. While the maximum sustainable fishery yields have been estimated at 50-70,000 mt annually, a large portion of these fishery resources are coastal pelagics such as sardines and anchovies which have little value except possibly for local human or animal consumption. Hence, the maximum sustainable yields of Eritrea's high quality food fish available for domestic consumption or export is more likely to be in the range of 20,000 mt annually. The fish stocks have been relatively under exploited for more than 20 years, and current efforts are harvesting only about 15-20 percent of these sustainable yields. The boats, gear, ice-making and cold storage facilities, roads, trucking, and marketing facilities have been severely degraded or destroyed. The fish stocks themselves, however, are probably healthier and more abundant than they were in the past, largely because the fish stocks were able to increase during the long period of under exploitation. Hence, as the Eritrean economy is rehabilitated, it is likely that there will be a rapid expansion in fish production. This will permit the fishery resources to contribute to employment, to local food supplies, and to the generation of foreign exchange. However, this opportunity could lead to a rapid expansion of fishing effort, which, if left unmanaged and unregulated, could lead to over-fishing and to serious reductions in the sustainable yields of the fishery.

There are several international donor assisted projects addressing the physical and marketing constraints on the expansion of the fishing industry; there is no international donor assistance directed to alleviating the principal constraint on the sustainable development of the marine resources, namely, Eritrea's lack of a fishery stock assessment and management system. Eritrea's Ministry of Marine Resources (MMR) needs to know the status of the fishery to be able to establish appropriate regulations and guidelines for its sustainable development. There are also no donor assistance programs directed to training Eritrean staff in the operation and maintenance of a fishery information system for monitoring and regulating the fishery.

Perhaps a quarter of Eritrea's continental shelf area is occupied by the Dahlak Islands Archipelago, a vast coral reef area located off Eritrea's north central Red Sea coastline. This archipelago is not only one of Eritrea's prime artisanal fishing areas, a natural home for its artisanal fishery, but also one of Eritrea's most valuable ecological, archeological, and historical treasures. The archipelago is the home of exotic wildlife and marine life, and approximately 1,000 species of fish and 220 species of coral are found there. The largest of the approximately 350 islands in the archipelago is Dahlak Kebir, the site of an ancient settlement from the Axumite Empire. It is one of Eritrea's most important archeological and historical sites. Despite the area's current lack of infrastructure, there is great potential for tourism development. The combined development of the fishery, tourism, industrialization and urbanization in the nearby coastal area of Massawa, and offshore oil and gas exploration is likely to present an increasing challenge to this fragile environment, potentially undermining Eritrea's employment and export earnings opportunities in fishing and tourism expansion. Yet, Eritrea's ability to manage the development of these coastal resources sustainably is limited, just as its ability to manage its fishery is limited. Eritrea has neither an integrated coastal resources management system nor the skilled and trained personnel to implement, monitor, or maintain such a system. Eritrea needs international donor assistance to provide technical assistance and training to develop an integrated coastal resources management plan to guide the sustainable development of its most valuable fishery and tourism resources.

It has long been suggested by ecologists and conservationists that a comprehensive marine area plan be developed for the Dahlak Islands Archipelago. It is important to recognize that to be useful and practical, such a comprehensive marine area plan must have a multiple use marine resource management system including some marine reserves, or marine parks, where activities are very restricted, and various multiple use areas where consumptive activities are allowed. This multiple use management scheme is the approach used successfully at the Great Barrier Reef Marine Park in Australia. Such a multiple use marine resource management scheme is an important coastal management tool for sound fishery development and environmentally appropriate urban, industrial, and tourism development. The MMR supports the policy of managing these multiple uses through the establishment of a marine resources planning area in the region, including fish replenishment zones and control areas for

fisheries managers to gauge the impacts of fishing effort in the fished areas. Other areas would be identified for tourism, diving, oil and gas exploration, aquaculture, harvesting, and fishing.

Creation of a multiple use marine resource management plan for the Dahlak Islands Archipelago would complement other international donor assisted projects focused on conducting a biodiversity and habitat survey in the region. The Dahlak Islands Archipelago has been selected for the initial marine resources management planning effort because of its vast size and importance to fishery and potential tourism development. Unfortunately, here again, Eritrea requires international donor assisted technical assistance and training in doing the initial survey and assessment work, identifying appropriate locations and boundaries for the fish replenishment zones and multiple use areas in a marine resource management plan for Eritrea's Dahlak Islands Archipelago, as well as the appropriate delineation of zones within the multiple use area, their sizes, regulations, and management schemes. Marine resource managers, planners, and rangers, and those installing pin-mooring buoys in reef areas, along with fishermen, divers, tourist guides, and neighboring communities, all need training and education if the marine resource management effort is to be successful.

Following this assessment of Eritrea's needs for technical assistance and training in fisheries stock assessment and management, integrated coastal resources management, and multiple use marine resources management, the RDA Team developed and designed an international donor assisted project which would supply the needed technical assistance and training to assist Eritrea in managing its fishery and tourist resources in the Red Sea area in a sustainable manner. The project was carefully designed and crafted to complement other current and proposed international donor assisted project activities. The three principal components of the project--(1) the establishment of a fishery stock assessment and management system for Eritrea's Red Sea fishery, (2) the establishment of an integrated coastal resources management planning system for the Dahlak Islands Archipelago and nearby mainland coastline, and (3) the establishment of a regional multiple use marine resource management plan for the Dahlak region--are all intimately linked to promote sound and sustainable fishery, tourism, and coastal and marine resources development in Eritrea. While it is recommended that the project be implemented as a single whole project, the design is modular, permitting international assistance donors to treat each of the three major components separately or sequentially.

In addition to designing the large modular project in sustainable fishery and other coastal and resource assessment and management, several other, smaller high pay-off project activities were designed. These include: (1) the black-lipped oyster abundance assessment project, (2) the marine reserve area identification project, (3) the design of interim commercial fisheries regulations project, (4) coastal resources management guidelines project, (5) evaluation of distant water fishing fleet proposals project, and (6) the MMR research vessel project.

2.0 INTRODUCTION

This chapter provides a more detailed overview and summary of the entire document, the role of the team, an overview of our itinerary, and our methods, including an overview of the workshop, a brief overview of the current conditions of Eritrea's coastal and marine resources, Eritrea's coastal and marine resources development strategy, resource assessment and project identification findings, and the recommendations. Section 2.6 on page 2-7 below carefully explains the structure of the report to guide readers to appropriate sections. Section 2.7 on page 2-8 below will tell the reader where in this report a response to each of issues raised in our scope of work can be found.

This Eritrea Coastal and Marine Resources Assessment and Project Identification Report was prepared by RDA International, Inc. for USAID/Asmara under Indefinite Quantity Contract Delivery Order No. PDC-5517-I-15-0104-00. An RDA Team, including a Team Leader/Economist (Dr. John T. Rowntree), a Marine Biologist (Elie I. Moussalli), a Coastal Resources Planner (David A. Tarnas), and a Fisheries Training Specialist (Frederick A. Jurick), visited Eritrea during 2-24 September 1993. The overall objective of the exercise was to assess the current status of Eritrea's coastal and marine resources and to identify international donor assisted project activities which would address the constraints on the sustainable development of these resources.

2.1 Specific objectives of the activity

The specific objectives of the activity were (1) to assess the current economic and environmental status of Eritrea's coastal and marine resources, (2) to identify and assess the physical, political, socio-economic, environmental, pollution, management, research, educational, institutional, and policy constraints on and opportunities for the sustainable development of these resources, (3) to prepare a preliminary development strategy and plan to address these constraints to promote the environmentally sustainable development of Eritrea's coastal and marine resources, (4) to describe ongoing and planned Eritrean Ministry of Marine Resources and international donor assisted development activities and programs, and (5) to recommend and design an international donor assisted program for implementing a feasible data collection and resource monitoring system, along with several initial high-payoff projects, which contribute to the environmentally sustainable development of Eritrea's coastal and marine resources.

2.2 An overview of the condition of Eritrea's coastal and marine resources

Eritrea's approximately 1,155 km mainland coastline on the Red Sea extends from the Sudan border in the northwest to the Djibouti border in the southeast. The total Eritrean coastline, inclusive of that of the islands principally in the Dahlak Islands

Archipelago in the north central part of the country, is about 1,720 km. Eritrea's continental shelf area of about 52,000 km^2, about 25 percent of which is occupied by the Dahlak Islands Archipelago, is about 40 percent as large as its land area of about 125,000 km^2.

The wide distribution of coral reefs along the continental shelf of Eritrea makes it a good environment for fisheries. Indeed, thirty years ago, Eritrea had an active fisheries sector with yearly catches exceeding 25,000 mt, even though about 80 percent of the catch was small pelagic species, sardines and anchovies, which were exported for fishmeal and are not particularly valuable in today's market. Annual production had fallen to about 14,000 mt by 1967, and then as the war took its toll, fish landings fell to about 4,000 mt by 1972 and to about 328 mt by 1980, before increasing somewhat to about 2,000 mt by 1984. Further disruptions caused by the war led to smaller fish yields throughout the 1980s, and today the fish catch is roughly estimated at about 500 mt annually. While there were some 23,000 fishers in the 1950s, the number had fallen to about 7,000 in the 1960s. It is estimated that there are about 2,600 fishers today, although most are not fishing in view of the disruption of the war, the debilitated state of their boats and equipment, the lack of ice, and the lack of storage, transportation, and marketing infrastructure.

Even in its poor situation, the fishers could increase their catch substantially if cold storage, transportation, and marketing facilities were improved. In fact, there could be a significant expansion of the fisheries sector once the infrastructure of the country is rehabilitated. Even aside from its low valued small coastal pelagic resources, estimates of the maximum sustainable yields from Eritrea's demersal and other marketable stocks suggest that Eritrea could reach 20,000 mt annually. The challenge will be to manage the sector sustainably.

Eritrea's coastline is characterized by rocky deserts, sand dunes and large salt marshes. Some mangrove stands are located in the central region near Massawa. Relict populations of exotic wildlife are found there, including gazelle, ostrich, jackal, and foxes. While there are small patch reefs along much of the coast, there are high quality coral reefs several kilometers offshore in these areas.

The principal urban centers along the coast are the port cities of Assab (with a population of about 60,000) in the south and Massawa (now with a population of only 22,000 which is down from a high of about 80,000 before it suffered war damage) in the north central area. Several smaller communities and villages are scattered along the coast which are somewhat inaccessible due to the poor roads along the coast. The Assab port is large and in good operating condition since it was built up by the Ethiopians. However, Massawa port, formerly the larger port, was severely damaged during the war. Massawa's housing, roads, water, electricity system, hospitals, and schools were all severely damaged by the war. Some of Massawa's sewage is being released directly into the sea. There is a refinery in Assab

and fuel storage facilities at Massawa. As reconstruction proceeds, increasing amounts of fuel and oil products will be handled, increasing the likelihood of serious spills. There are also major salt works and a cement factory in Massawa. As Massawa is rebuilt and as Assab expands, there is an urgent need to ensure that these developments do not adversely affect the coastal and marine environments.

In southern Eritrea, there are some offshore islands, including an island group south of Assab, with Haleb island being the largest. The major islands and coral reef area, however, are the Dahlak Islands Archipelago, east and north of Massawa. Altogether there are over 350 islands in the Dahlak Islands Archipelago, along with extensive shoals and coral reefs extending up north to Saunders Reef at the edge of the Dahlak Bank. Only about four of the islands are inhabited, the largest being Dahlak Kebir. While the land masses are arid and have a desert environment, the islands are surrounded by significant mangrove areas and by large areas of coral reef and seagrass. The ecosystem in the archipelago has a relatively high level of endemism. Many marine creatures are unique to this area. In total, approximately 1,000 species of fish and 220 species of coral are found here. Among its creatures are found dugongs, whales, dolphins, and three species of sea turtles. Dahlak Kebir also has remains of a large settlement from the Axumite Empire, making this one of Eritrea's archeological and historical treasures.

This unique environment not only is an ideal location for an artisanal fishery, but it is also ideal for tourism development. However, there currently is limited tourism on the islands, mainly due to the lack of infrastructure. At the same time, there is major shipping activity in the region and there is likely to be significant exploration for offshore oil and gas in the near future. Even though currently the coastal resources of Eritrea are not heavily utilized or under great stress, the combined development of the fishery, tourism, industrialization and urban expansion, and oil and gas exploration are likely to present an increasing challenge to this fragile environment. The Dahlak Islands are very suseptable to environmental damage. Degradation of these resources would be a serious detriment to sustainable development of the fisheries and tourism resources of Eritrea.

2.3 An overview of a sustainable development strategy for Eritrea's coastal and marine resources

The Eritrean Ministry of Marine Resources has expressed great concern for promoting the sustainable development of Eritrea's coastal and marine resources. The MMR has the stated objective of promoting the exploitation of marine resources in a manner that results in maximum national benefits on a sustainable basis. The MMR is clearly aware of the challenges maintaining the biological productivity of the marine resources, of balancing the competing demands for the same marine resources, and of protecting those marine resources which are not of direct monetary value such as the dugong and other endangered or threatened species. Accordingly the MMR has

developed an action plan for marine environmental protection. The plan consists of developing the capacity to manage marine resources to provide maximum sustainable benefits, addressing the activities needed to prevent direct pollution of the marine environment, developing the capacity to undertake Integrated Coastal Zone Management in order to guide essential and desirable coastal developments to produce maximum benefits and minimum costs, and addressing the issues associated with maintaining the biodiversity and health of the marine environment. This is an ambitious environmentally oriented strategy for developing Eritrea's coastal and marine resources. It appears to be the correct strategy for promoting the sustainable development of Eritrea's coastal and marine resources. However, there are many challenges in its successful implementation.

Beyond the challenges of developing the infrastructure required to expand the artisanal fishery--challenges which are being addressed jointly by the Eritreans and by donor assisted projects--there are the institutional capacity constraints on being able to develop these resources in a sustainable manner. In particular, there is a critical lack of information that is needed in order to manage these fishery resources on a sustainable basis. There is no reliable information on the current status of the fishery. Nor is there the trained staff which can collect the relevant information, develop the required fishery regulations, and monitor the exploitation of the resources.

To address these institutional and trained personnel constraints, there is an urgent need to acquire outside assistance to help establish a fishery stock assessment and management system, a system of regulations, and a system of monitoring and control, along with training the required personnel, in order that the sustainable development of these fishery resources can be pursued in earnest. The MMR is taking a cautious expansion policy due to lack of information and inability to field trained fishery observers. There is great pressure to rapidly expand Eritrea's fishery production by allowing large industrial scale fishing by foreign firms. However, there is rightful concern that this development approach would undermine the long term growth opportunity for the local fishing community.

Committed as it is to a regional development policy for the whole coastal area rather than just the development of Massawa and Assab, the MMR plans to involve local communities in management activities and decision-making to ensure that over exploitation of its marine resources does not occur. The implementation of this ambitious strategy will require the establishment of a fishery stock assessment and management system and an integrated coastal resources management plan, complemented by the establishment of a multiple use marine resources management plan for the Dahlak Islands Archipelago to provide marine reserves to serve as fish recruitment and replenishment areas, to provide scientific research areas, and to promote tourism and other marine resources development alternatives.

2.4. A profile of some potential international donor assisted project activities

Based on a thorough review of the constraints and opportunities confronting the sustainable development of Eritrea's coastal and marine resources, a major international donor assisted project has been designed to assist the MMR and Eritrea in this task. The project is consistent with MMR's own development strategy, and is designed to complement other implemented and proposed donor assisted projects in fisheries and other related coastal resources areas.

The recommended project, carefully designed and developed in section 7.0 of this report, would provide the necessary technical assistance and training to establish and maintain a coastal and marine resources management system which would promote the continued sustainable development of these resources. The key features of the recommended project are 1) the establishment of a fishery stock assessment and management system for Eritrea's Red Sea fishery, 2) the establishment of an integrated coastal resources planning system for the Dahlak Islands Archipelago and nearby mainland coastline to promote environmentally appropriate urban, industrial, and tourism development, and 3) the establishment of regional multiple use marine resources management planning system for the Dahlak region to promote sound fishery development and compatible uses of the marine and coastal resources.

The recommended project is organized around the key concept that sound environmentaly sustainable management of Eritrea's coastal and marine resources must be based on appropriate, accurate, and timely information on which resource management policy, prescription, and enforcement can be based. Sustainable development of natural resources requires an on-going dynamic process of information collection and analysis that is integrated with a continuing process of policy review, evaluation, and adaptation. The project activities recommended here are focused on providing technical assistance and training to the MMR and other related agencies necessary to develop an appropriate information management system for promoting the sustainable development and management of Eritrea's coastal and marine resources sector. The development of an on-going fishery stock assessment capability that is based on the output of a sound information management system is the central component of the recommended project. In addition, ensuring the sustainable development of the fishery sector requires that related coastal resources development, such as tourism, urban, and industrial uses, be integrated into an overall sector-wide strategy. Furthermore, the development of a regional multiple use marine resources management plan, particularly in the Dahlak Islands Archipelago, provides a key link between the sustainability of the fishery and ecologically sound tourist developments in the region.

While it is recommended that the entire project be conducted as a whole, the project has been designed in a modular fashion so that each of the major components could

be funded and implemented separately and sequentially if the international donor community should choose to assist by more modest steps.

It is also recognized that large international donor assisted projects often take a long time to contract and implement. Hence, several other smaller, well-targeted, high pay-off project activities have been identified, and brief project profiles were developed for each of these activities. Each of these small projects are presented with a project description, project objective, brief scope of work, and budget. The small projects are: (1) the black-lipped oyster abundance assessment project, (2) the marine reserve area identification project, (3) the design of interim commercial fishing regulations project, (4) the coastal resources management guidelines project, (5) the evaluation of distant water fishing fleet proposals project, and (6) the Ministry of Marine Resources research vessel project. Each of these small projects could be implemented quickly and inexpensively, yet, would have a significant impact on the development of the coastal and marine resources of Eritrea.

2.5 Methods of the RDA Team

The RDA Team spent approximately three weeks in Eritrea during September 1993. Enroute to Eritrea, RDA Team members visited the UNDP/GEF offices in New York and the FAO offices in Rome to discuss the work of those organizations on the coastal and marine resources in Eritrea. The recently produced FAO/TCP reports on the fisheries sector were an invaluable source of background information. In Eritrea, in addition to interviewing Eritrea Ministry of Marine Resources staff members and other Government officials, representatives from the private sector, and fishermen, the RDA Team met with USAID officials and representatives from other international donor agencies and international donor assisted projects. The RDA Team read reports and documents, visited fish markets and fish landing sites, talked with fishermen and representatives of the Fishermen's Cooperatives, spent several days on the Dahlak Islands Archipelago, talking with fishermen and others, and snorkeling and scuba diving. In both Massawa and in Assab (to which the team traveled by air), the RDA Team met with Ministry of Marine Resources and other government officials, visited fish landing sites, fish markets, fish buyers in hotels and restaurants, the ports, industrial plants, and so forth. On the return air trip from Assab to Asmara, the RDA Team was given a low altitude aerial tour of the Dahlak Islands Archipelago. At the end of the RDA Team's first week in Asmara, the team conducted a facilitated workshop to solicit views of the development of Eritrea's coastal and marine resources. Attending the workshop, and sharing a diversity of views on the Eritrea's coastal and marine resources, were Ministers, Department heads, University professors, Fishermen's Cooperative representatives, and individuals from the areas of fisheries, industry, tourism, agriculture, energy, and urban planning. Appendix B contains the RDA team's itinerary, Appendix C has the list of contacts made by the RDA team, and Appendix E contains the full report of the facilitated workshop.

Based on all of the information the RDA Team obtained from the above activities, the RDA Team produced an assessment of Eritrea's coastal and marine resources, identified and designed a critically needed international donor assisted project in fisheries stock assessment and management, coastal resources management, and marine resources management. While all components of the project are needed, the project was designed in a modular form, so that the three major components could be addressed separately or together as a single project. In addition, several small, targeted, high return project activities were identified, and brief project profiles were developed for each of these activities.

2.6 Structure of the report

Following the Executive Summary (Chapter 1) and the Introduction (Chapter 2) to this report are several chapters which present an overview of the Eritrean coastal and marine resources (Chapter 3), a discussion of the constraints on and opportunities for the sustainable development of Eritrean coastal and marine resources (Chapter 4), a presentation of a coastal and marine resources development strategy (Chapter 5), and a review of international donor assistance activities, plans, and needs (Chapter 6). This is followed by a detailed summary and development of a recommended large long-term international donor assisted coastal and marine resources management project (Chapter 7). In this chapter, a brief project profile (Section 7.1) is followed by a discussion of the problem (Section 7.2), the project objective (Section 7.3), project strategy, organization, activities, and milestones (Section 7.4), human and physical resource requirements and constraints (Section 7.5), several technical fishery resource management, economics, and coastal and marine resource management issues (Section 7.6), environmental issues (Section 7.7), project costs and benefits (Section 7.8), and a project summary (Section 7.9). Short project profiles of six smaller short-term well-targeted high-payoff international donor assisted project alternatives are presented in Chapter 8. This is followed by the summary and conclusions (Chapter 9). Appendices include the RDA Team scope of work (Appendix A), the Team's itinerary (Appendix B), a list of contacts (Appendix C), references (Appendix D), and a summary of the results of a coastal and marine resources strategy development workshop conducted by the RDA Team with numerous Eritrean government officials and private individuals (Appendix E).

2.7 Scope of work

While an overview of the objectives of the assessment and project identification team's efforts were presented above in Section 2.1 on page 2-1, and the actual scope of work is presented in Appendix A, this section will present a guide to where specific responses to questions raised in the scope of work may be found in this report.

Task 1: An analytical description of Eritrea's coastal and marine resources, including the current status of the fisheries resources, the level of exploitation, fishing

technologies employed, and employment and income generated, is found in Chapter 3 which begins on page 3-1, with additional technical discussions in Section 7.6 which begins on page 7-45. Discussions of the capabilities of the Ministry of Marine Resources (formerly the Department of Marine Resources and Inland Fisheries) are found in Chapter 4 beginning on page 4-1, Chapter 5 beginning on page 5-1, and Section 7-2 beginning on page 7-9. An overview of on-going and planned projects of the MMR, FAO, and other donors is found in Chapter 5 beginning on page 5-1 and Chapter 6 beginning on page 6-1.

Task 2: The constraints on and opportunities for coastal and marine resources development are identified and discussed directly in Chapter 4 beginning on page 4-1 and indirectly in Chapter 5 beginning on page 5-1.

Task 3: A review and assessment of the current environmental status of the coastal zone, including an identification of current or potential impacts of fishing, tourism, urban development, and pollution, are found in Chapter 3 beginning on page 3-1.

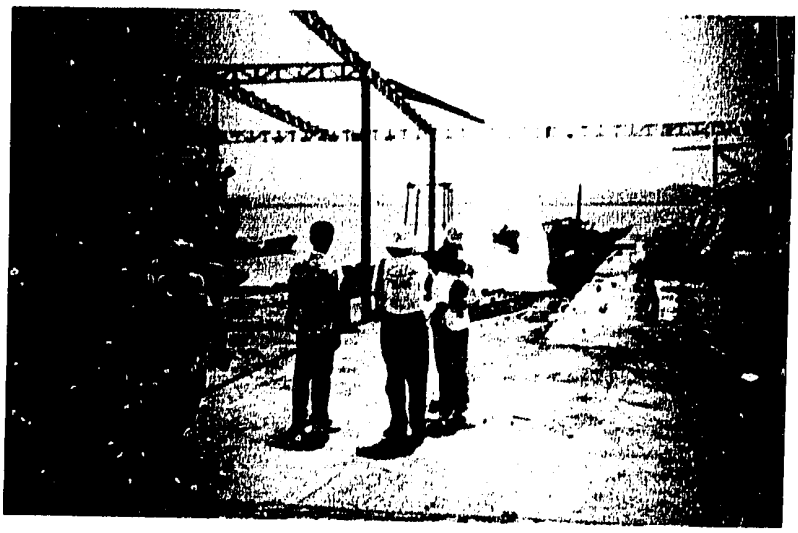
Task 4: A review of current institutional and policy constraints on implementing the sustainable development of coastal and marine resources, along with suggested options for removing or reducing these constraints, is presented in Chapter 3 beginning on page 3-1, Chapter 4 beginning on page 4-1, and section 7.2 beginning on page 7-9.

Task 5: An assessment of the management, research, and education requirements for ensuring sustainable development of coastal and marine resources and the recommended investment and policy strategy for meeting these requirements, including an assessment of the MMR proposal to establish a Marine Technology Training Center in Hargigo, are presented in section 7.5 beginning on page 7-36.

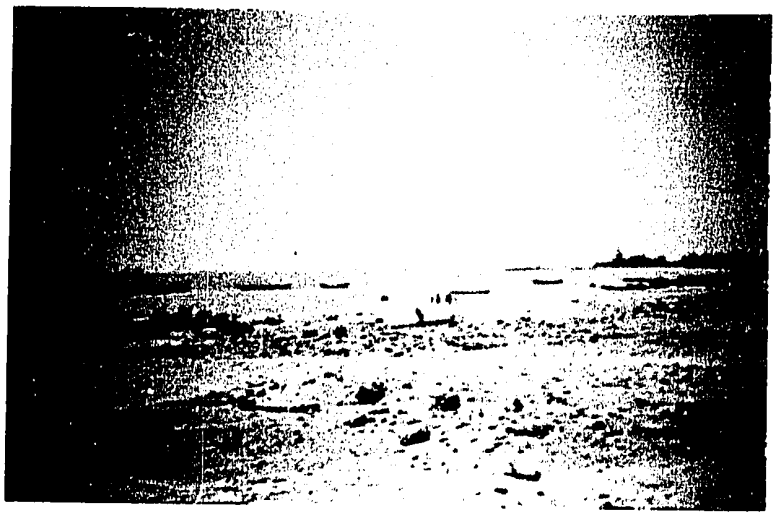
Task 6: A feasible data collection and resource monitoring system, including the approximate cost and suggestions on how to institute it, which will be needed to support sustainable exploitation of the coastal and marine resources is recommended in Chapter 7 beginning on page 7-1, with particular reference to section 7.3 beginning on page 7-15, section 7.4 beginning on page 7-19, and section 7.6.1 beginning on page 7-45.

Task 7: A description of on-going and planned MMR and donor programs are discussed in Chapter 6 beginning on page 6-1, with some related discussion in Chapter 5 beginning on page 5-1. Several initial project alternatives, which may be funded by USAID and/or other donors, which have immediate high-payoffs and contribute to the environmentally sustainable development of coastal and marine resources are identified in Chapter 7 beginning on page 7-1 and in Chapter 8 beginning on page 8-1.

Task 8: A preliminary development strategy and plan for the environmentally sustainable development of Eritrea's coastal and marine resources is presented in Chapter 5 beginning on page 5-1, with related discussions in section 7.4 beginning on page 7-19.



MMR fish landing site in Massawa.



MMR fish landing sites in Assab.

3.0 OVERVIEW OF ERITREAN COASTAL AND MARINE RESOURCES

This section provides an overview of Eritrean coastal and marine resources. First, a brief description of the country of Eritrea and its general political, economic, and social condition is presented. This is followed by a review of these coastal and marine resources, including a description of the physical setting of Eritrea's fishery resources, an historical review of the fishery, and a description of their current utilization. Lastly, a review of current utilization of Eritrea's other, non-fishery, coastal resources is presented.

3.1 An overview of Eritrea

Eritrea is a country of approximately 3.2 million people living on approximately 125,000 sq km. In the northeastern part of the African continent, it has a 1,155 km coastline on the Red Sea. It lies southeast of Sudan and north of Ethiopia, with Djibouti at its extreme southeast tip. The reader may refer to the map on page v for a general understanding of the location of Eritrea. Four of Eritrea's eight provinces share the Red Sea coast, Sahel in the north, Semhar and Akele Guzai in the middle of the country, and Danakalia in the south. Asmara, the capital city, sits in the highlands at about 2,400 meters. It is only about 100 km, but a three hour drive, from Massawa, the major port city in the north in the Semhar province. Assab is the major port city in the south. Most of the people live in the highlands, and 80 percent of Eritreans earn their livelihood from agriculture, livestock, and fishing (World Bank 1992).

Eritrea is among the poorest countries in the world. The World Bank estimates Eritrea's GDP per capita at between US$70 and US$150, as compared with that for Sub-Saharan Africa as a whole at US$330. Eritrea's life expectancy is 46 years, compared with the Sub-Saharan African average of 52 years; its infant mortality is 135 per 1000 live births compared with the Sub-Saharan average of 109; it has only one physician for every 48,000 people, compared to Sub-Saharan Africa's one for every 24,000; an adult illiteracy rate of 80 compared with 58; and its daily calorie intake is 1750 compared to 2096 for all Sub-Saharan Africa. It has long been a poor country, but a devastating 30 year war for liberation from two successive Ethiopian regimes made the economic conditions of living in Eritrea among the worst in the world (Reynolds, *et al.* 1993a).

3.2 The social-economic context

Eritrea has emerged from three decades of war and economic mismanagement by the previous regime with much of its infrastructure devastated and its productive capacity severely curtailed. Recent droughts have added to its economic decline. The infrastructure in every sector of the economy has been destroyed or degraded. Food production fell by about 40 percent during the 1980s. It is reported that most

industrial plants which have not been closed are operating at 25 to 30 percent of their capacity due to partial destruction, the inability to buy spare parts, and/or the shortage of energy. Eritrea lost much of its human capital during the war. It is reported that there are about one million Eritreans living abroad, many of whom were among the more skilled labor force, and a generation of Eritreans went untrained or uneducated as they struggled to oust the previous regime (World Bank 1992).

Although there are few statistics on the economy, including there being no data available on national income, international trade, banking, or aggregate wages and prices, it is clear that every sector of the economy is in a terribly degraded situation. The Provisional Government of Eritrea instituted an emergency recovery and rehabilitation program in 1991, and the Government of Eritrea, in existence for only about four months at the time of this mission, is continuing this effort. In this emergency situation, the Government has taken the initiative to get the basic infrastructure rehabilitated and basic services functioning. The Government is involved in virtually every aspect and every sector of the economy. While the previous government established a command economy by policy, the new Eritrean Government now has charge of a command economy almost by default, the private sector having been virtually decimated by the previous regime.

The Government's stated policy is to encourage a private free market in the fisheries sector and throughout the economy. A Property Commission was established to examine disputed ownership of property seized by the Ethiopian government, and many houses and other properties and production facilities have been returned to their previous owners (World Bank 1992). In an effort to create an environment conducive to the development of the private sector, the Provisional Government of Eritrea (1991) proclaimed an investment code which guaranteed that there would be no nationalization or confiscation of private capital assets without due process of law. The investment code also declares that the Government would neither establish mandatory pricing or government monopolies in a wide range of activities in which foreign investment is being encouraged, e.g., in agro-industries, industrial production, civil and water works, tourism and hotels, air transport, and communications. While this proclamation may put at ease the fears of foreign investors, neither in the fisheries sector nor in other sectors of the economy will the transition to a private market economy be a speedy or easy one. There are currently few Eritreans with any capital, the market institutional and infrastructural framework is in shambles, and the banking and credit system is barely functioning.

While the fishery sector has been devastated, just as have other sectors of the Eritrean economy, the fishery sector is exceptional in that the fishery resources themselves were not destroyed by the war or the recent drought which have had such a drastic impact on other resource bases. In fact, as has been noted several times in this report, it is likely that the fishery stocks are more abundant now than they were 25 years ago due to probable under exploitation during the war. Thus, the

rehabilitation of the fishing sector may proceed rather quickly once cold storage and transportation facilities are reconstructed and marketing channels reestablished.

Despite the condition of the economy, however, there is among the Eritrean people a well deserved self confidence and a pervasive sense of optimism about the future. Eritreans are engaged in an exciting process of rebuilding their country. Having won their independence against all odds, and with little outside help, the Eritrean political environment is one conducive to change and development.

3.3 Review of Eritrea's fisheries and marine resources

This section is based on the available information in reports and publications on Eritrea's fisheries resources. Given that very little new information is published on Eritrean fisheries, this review will rely on FAO's Technical Cooperation Programme (referred to here as the FAO/TCP Project), the Sector Studies reported thereunder and references therein.

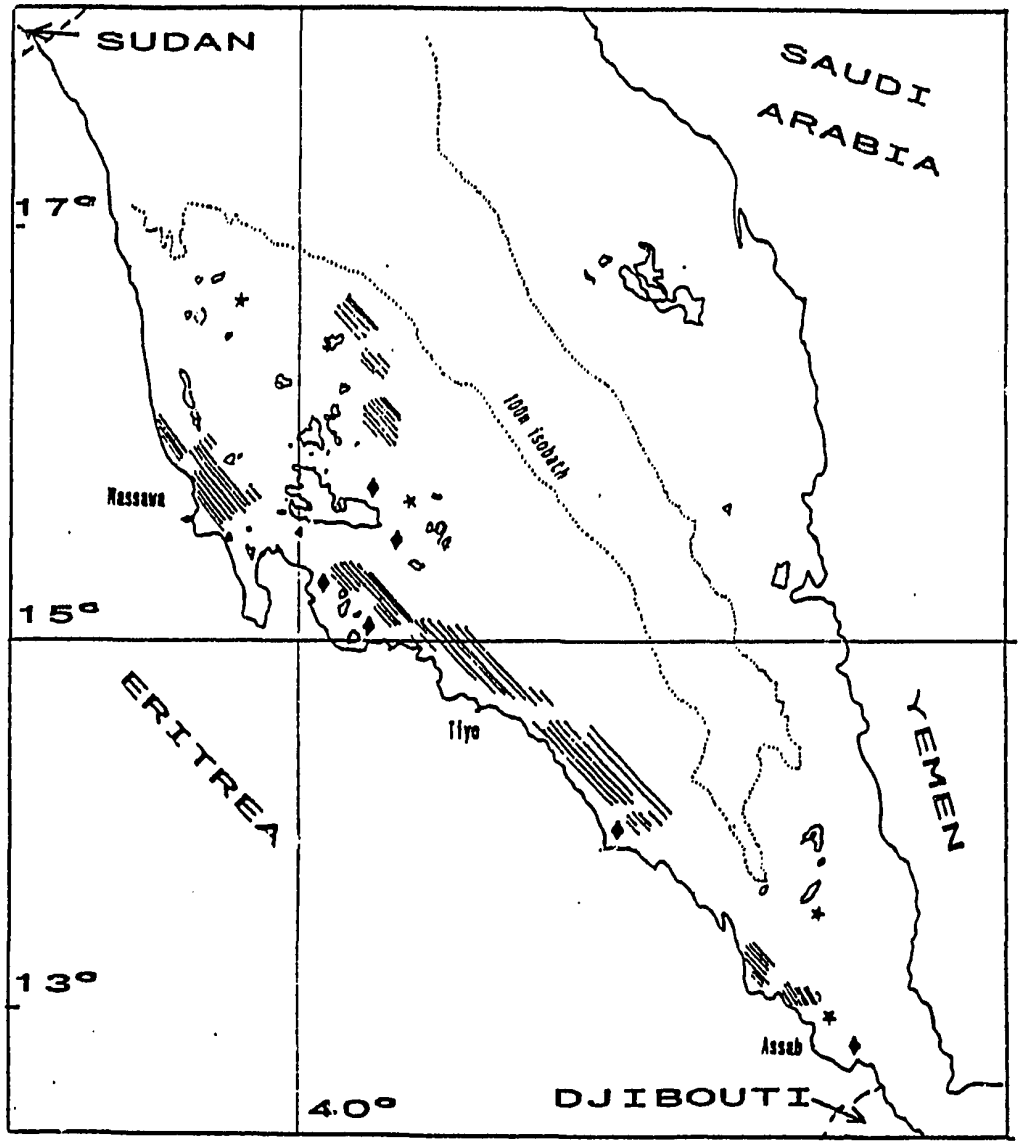
3.3.1 The physical setting of Eritrea's fisheries

Eritrea's coastline is roughly 1,720 km long inclusive of about 565 km, around the islands on the continental shelf. Eritrea's continental shelf of about 52,000 km^2, in the 0-200 m depth, is equal to about 40 percent of its total land area. A quarter of this continental shelf is occupied by the plateau of the Dahlak Islands Archipelago between 0 and 35 m of depth. The continental shelf is widest at the latitude of the Dahlaks narrowing down at the north of the archipelago to about 15 km and at the south to about 30 km (Guidicelli 1984). The reader is referred to the map in Figure 3-1 on page 3-4 for an overview of the main past fishing areas in Eritrean Red Sea waters.

The seasonal pattern of the winds defines two seasons. During the winter season of November through April wind velocities range from 16 to 65 km/hr blowing south to south-easterly. This hinders traditional fishing craft from venturing too far out to sea, particularly in the area close to the Bab El Mandab Straits in the south. In the summer season of May through October, north-westerly winds hardly exceed 10 km/hr. Tidal ranges are narrow, at less than 1 m, and the sea state is more a function of atmospheric conditions than of oceanographic ones.

The wide distribution of coral reefs along the continental shelf of Eritrea makes it an ideal environment for the development of traditional fisheries. Guidicelli (1984) delineates areas outside the coral reef belt where trawling operations took place along the flat sedimentary bottom.

Figure 3-1 Map of major past fishing areas in the Eritrea Red Sea waters[a]



[a]/Adapted from Grofit (1971).
\\\ = Trawling grounds.
★ = Commercial handling.
♦ = Shark gillnetting.

Source: Bellemans and Reynolds 1992 b

3.3.2 Historical review of Eritrea's fisheries

Eritrea had an active fisheries sector thirty years ago with yearly catches reported in 1954 exceeding 25,000 mt. Most of this catch (80%) was of small pelagic species (sardines and anchovies) earmarked for export as fishmeal (Aubray, 1975). Internal markets were weak and most of the catch was oriented to the export market as foodfish, dried shark, and shells. Based on Grofit (1971), Table 3-1 shows a record of fish landings in Eritrea from 1954/55 to 1983/84.

Table 3-1 Evolution of marine resource landings in Eritrea from 1954/55 to 1983/84, (in '000 mt)

Species groups	1954 /55	1962 /63	1963 /64	1964 /65	1965 /66	1966 /67	1967 /68	1968 /69	1969 /70	1970 /71	1971 /72	1972 /73	1973 /74	1974 /75	1975 /76	1976 /77	1977 /78	1983 /84
Pelagic	25.0	6.7#	7.0#	16.3#	19.7	17.9	6.8	9.0	13.0	19.0	11.0	2.0	3.5	2.0	0.25	-	-	n/a
Demmersal	n/a	1.6	1.3	1.2	1 3	1.2	1.2	1.5	0.1	1.2	1.2	1.0	0.6	0.4	0.6	0.15	0.15	n/a
Sharks	n/a	n/a	n/a	n/a	1.1	1.3	5.5	1.9	1.5	2.3	1.1	0.4	0.5	0.03	0.1	0.01	-	n/a
Lobster/ Shrimps	n/a	n/a	n/a	n/a	0.009	-	-	0.1	0.08	0.03	0.03	-	-	-	0.02	-	-	n/a
Shells	0.3	0.2	0.1	0.2	0.15	0.2	0.2	1.2	0.4	0.4	0.5	0.3	0.3	-	-	0.004	-	n/a
Totals	25.3	8.5	8.4	17.7	22.3	20.6	13.7	13.7	15.0	22.9	13.8	3.7	4.9	2.4	0.97	0.16	0.015	2.0

All statistical data referring to the former Ethiopian fisheries were tabulated according to the Ethiopian financial year, which started on 7th June and ended on 8th June the following year. (The Ethiopian calendar lags behind the Gregorian calendar by 7.5 years.) Production data for the former Ethiopian fisheries are scarce and frequently contradictory. Figures from the sixties according to Grofit(1971).

Source: Bellemans and Reynolds 1992b

Ben Yami (1964) reported that six fishmeal plants were operating in Massawa using the output of 2-3,000 fishermen, primarily employing beach seines during the winter season. Exports of fishmeal to the European market were estimated at 1,000 mt and exports of dried fish products to the Far East at 3,000 mt. The closure of the Suez Canal in 1967 also blocked the most economical export route of the fishmeal industry in Eritrea, and total production fell from 21,000 mt in 1966 to 14,000 mt in 1967. By 1972 landings fell to 4,000 mt and because of increasing internal strife, the fisheries sector collapsed, with fish landings falling to about 328 mt in 1980. Catch records show increased landings of up to 2,000 mt by 1984 in Assab and Massawa, but this was followed by further disruptions due to warfare and more informal exports to Yemen and Saudi Arabia. A small internal market for fresh, iced fish developed in Massawa which transported about 200 mt per year to Asmara and Addis Ababa. About 1,500 mt of frozen fish were exported to Israel by two private firms operating five trawlers (Ben Yami, 1984).

The artisanal fleet underwent significant changes during the decade of the sixties with a shift towards the use of more motors (see Table 3-2 below). The basic fishing techniques, however, remained the same, with fishers using handlines, beach seines, gillnets (for sharks) and, to a lesser extent, longlines and troll-lines (Bellemans and Reynolds 1992b).

Table 3-2 Fishing boats in the 1960's

Type of boat	1962/63	1966/77
Canoes	433	174
Canoes with outboard	n/a	78
Sailing dhows	184	275
Motorized dhows	21	52
Stern trawlers	9	11
Rowing boats	n/a	(est) 214

Source: Bellemans and Reynolds 1992b

Despite the trend towards motorization, Grofit (1971) reported a decline in the number of fishers from 23,000 in the fifties to 7,000 in the sixties. In 1970 there were only about 5,000 fishers, about 80 percent of which operated on a part-time basis. Guidicelli (1984) observed 250 full-time fishers operating in the Assab area.

Eritrean fishers have adopted a variety of fishing gear and methods that have successfully withstood the test of time in the tropical reef environment. The RDA Team confirmed the observations of Eritrean fishermen made by earlier researchers (Guidicelli 1984, Grofit 1971, and Aubray 1975). A variety of gear, sometimes in combinations, is used depending on the season, the target species and the demand from the market. Prime reef fishes (snappers, groupers, breams) are caught using handlines. Gillnets are used to catch shark, and trolling-lines are used are used while traveling to and from the fishing grounds. Beach seines were commonly used to catch anchovies and sardines, and the skill has not been lost. Largely owing to this tradition of seamanship and fishing competence, Eritrea's fishermen have access to all available artisanal fishery technologies and resources and could be relied on to catch a lot of fish.

3.3.3 Current utilization of available fisheries and marine resources

All persons along the chain of production and distribution agreed that there are no problems with catching more fish. Comments from fishermen as well as from fish buyers indicate that production can easily be doubled or even tripled simply by expending more fishing effort. The constraints are not technological but in the

processing sector (ice plants, cold stores and shoreside facilities) and in the marketing sector (distribution network, promotion of consumption). Eritrea's fisheries sector is poised for a major expansion and the challenge facing the MMR is to manage the sector sustainably.

Despite the fact that no comprehensive quantitative surveys have been made to give a complete picture of Eritrea's fisheries resources, enough is known from work already done, to proceed with the development of the fisheries sector. Estimates of production were based on short-term investigations of specific stocks and catch rates from experimental fishing operations (Sanders and Morgan, 1989). FAO's Sector Study No. 3 (Bellemans and Reynolds 1992b) reproduced the figures shown in Table 3-3 which are based on earlier studies.

Table 3-3 Estimates of MSY of Eritrean fisheries ('000 mt)

Resource	MSY[a]	MSY[b]	MSY[c]
Demersal fish	10-15.0	8.5	18.0
Shrimp	0.5	0.5	0.5
Spiny Lobster	0.5	---	0.5-1.0
Coastal Pelagics	50.0	25.0	25-50.0
Oceanic Pelagics	----	----	5.0
Sharks	5.0	2.0	2.0-5.0
Total	66-71.0	36.0	51-79.5

Sources: [a] Atkins (1965), Ben Yami (1964), Grofit (1971), Atkins and Grofit in Aubray (1975); [b] Gaudet (1981); [c] Guidicelli (1984)

Though the above figures may be disputed or argued on several grounds, the important point to remember is that management of fisheries resources is never done with perfect information. Following a simple adaptive management rule, the MMR can set an annual Total Allowable Catch (TAC) which should be chosen conservatively and cautiously. What is needed then is an information system that can reliably (i.e. within an acceptable margin of error) track catch and effort statistics and their spatial and temporal distribution. Though conceptually simple, the collection, entry, and processing of fisheries statistics can be an elaborate process. The ability to produce simple summary statistics can actually go a long way towards comparing the production figures with the TAC. Management of resources should be designed not only to increase catch but to increase information about the status of the resource. Technical issues of stock assessment, fisheries management, fleet dynamics are discussed in section 7.6 on page 7-45 below.

Although currently, fishers are primarily targeting demersal species for the local market and shark for the export market, we can safely presume that most, if not all, of the above resources are within reach of the Eritrean fishermen.

In summary, we can think of Eritrean coastal and marine resources, particularly fisheries resources, as an endowment of natural capital out of which Eritrean society, now and for the foreseeable future, can derive material benefits. Proceeding cautiously, it is possible to keep the capital intact and bequeath it to future generations if Eritrean society is satisfied with the stream of interest from this capital.

3.4 Review of current use of coastal resources

3.4.1 The natural environment of the coastal plain

Rocky desert, sand dunes and large salt marshes characterize the Eritrean Red Sea coastline. The sandy and rocky coast is a[illegible] with numerous wadis of flowing sands that meet the sea. There are also some mangrove stands located in the central region near Massawa. Hillman (1993a) describes this wild and rugged country as providing important habitat for three Gazelle species, being the Soemmerring's, Dorcas (*Gazella dorcas*), the Red-fronted Gazelle (*Gazella rufifrons*), and the endangered Wildass (*Equus africanus*). Also, ostrich (*Struthio camelus*), golden jackal (*Canis aureus*), and foxes (*Vulpes sp.*) are found here. These wildlife are characterized as relict populations that may be experiencing a population growth now that the war is over and fewer firearms are available (Hillman 1993a).

There are small patch reefs along much of the coast, offshore the expansive sandy beaches and salt marshes. Because of high sedimentation rates and suspended silt in the water, the coral reefs close to shore are not well developed or diverse. However, there are reports of high quality coral reefs three or kilometers offshore in these areas. The Bay of Zula exhibits a nearly continuous fringing reef on its eastern side and evidence of patch reefs in deeper water. Coral and fish diversity was reported to be high and water clarity good (McClanahan 1993).

3.4.2 Human uses of the mainland coast

The communities along the Eritrean coast consist of the largest urban centers of Assab and Massawa, and several smaller communities including Ingel, Harena and Gelyalo, and the villages of Beylul, Berasali, Edd, and Tiyo. These smaller communities are all scattered along the coast and very remote.

In the south of Eritrea, Assab is the major town with over 60,000 people. It is made up largely of dense neighborhoods of small wooden structures. Officials report that there is a high percentage of illegal housing with inadequate sewage and solid waste management. However, the solid waste situation is much improved over the time when the Ethiopians controlled the city. At that time, large quantities of solid waste were reported to litter the beaches. In the two years since liberation, the Eritrean government has successfully relocated the landfill, initiated a solid waste collection

scheme, and removed most of this trash. This has significantly reduced the public health and environmental health problems caused by such uncontrolled dumping.

The major industrial activities in Assab are the refinery and the port. The refinery is about 30 years old and was built by the Soviets. It produces about 15,000 barrels per day of various refined petroleum products, such as LPG, regular petrol, kerosene, jet fuel, diesel, two grades of bunker oil, and asphalt. The refinery does not produce any lubricating oils. Since the refinery is old and difficult to repair due to lack of spare parts, there are plans being considered for building a new refinery. However, an expansion of the existing one may come first. They have not experienced any oil spill problems in the past due to the small size of the facility and the establishment of a deballasting system. Every tanker that services the refinery is required to deballast its tanks into the system. This dirty ballast water is then separated, the oil products mixed with crude oil for refining, and the water discharged several kilometers away in an inland sump. The ship's captain is then issued a certificate that is shown to the harbor master before given permission to depart from the port.

The port of Assab is the major port of Eritrea. Though the port of Massawa was larger ten years ago, the Ethiopians invested heavily in the development and expansion of the Assab port. This was primarily done since Assab serves as the transhipment center for goods going into Addis Ababa. A major road was also built connecting Assab with Addis Ababa. In 1992, over 1.8 million tons of commercial cargo was brought into the port, and nearly 612,000 tons of aid cargo (Ports and Maritime Transport Authority 1992a). Cargo data for the first half of 1993 show slight declines in cargo handled, and significant declines in passengers through the port. The number of ships, on the other hand, has increased (Ports and Maritime Transport Authority 1993a). See Table 3-4.

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Table 3-4. Comparative statistics of Assab Port in the first half of 1992 and the first half of 1993

Type	1st half 1993	1st half 1992	Variance amt	Variance %
Ships:				
Dry cargo	139	125	14	11.2
Tankers	63	49	14	28.6
Passenger	-	-	-	-
TOTAL	202	174	28	16.1
Cargo handled (tons)				
Discharged:				
Dry	466,173.1	533,773.8	-63,600.7	-12.7
Fuel oil	439,116.7	461,178.1	-22,061.4	-4.8
Subtotal	905,289.8	994,951.9	-89,662.1	-9.0
Loaded Cargo				
Dry	57,096.3	56,821.3	275	0.5
Fuel Oil	119,619.9	121,700.5	-2,080.6	-1.7
Subtotal	176,716.2	178,521.8	-1,805.6	-1.0
Discharged and loaded				
Dry	523,269.4	590.595.1	-67,325.7	-11.4
Fuel	558,736.6	582,878.6	-24,142.0	-4.1
TOTAL	1,082,006.0	1,173,473.7	-91,467.7	-7.8
Passengers				
In	158	1,745	-1587	-90.9
Out	498	1,845	-1347	-73.0
TOTAL	656	3,590	-2934	-81.7
Cargo delivered (tons)				
	524,570,764	367,991.1	156,579.664	-42.5
Trucks deployed	23,126	15,788	7338	46.5

(Ports and Maritime Transportation Authority 1993a)

Even though there is a great deal of oil and oil products being transhipped and off-loaded here, there is not however, any oil spill prevention, cleanup or emergency response plan, equipment or personnel at the Assab port. Consequently, the major pollution concerns are in the shipping, transport, and transfer of oil, and land-based oil storage.

North of Assab are the small villages of Ingel, Harena, Gelyalo, Beylul, Berasali, Edd, and Tiyo. These are small settlements and very remote. They are reported to be primarily fishing villages at a subsistence level. Little agriculture takes place due to its arid environment.

South of Massawa, in the Gulf of Zula and Hargigo Bay, extensive stands of mangrove exist. About thirty kilometers south of Massawa lies the ancient Axumite port of

Adulis. It is a major historical site and could attract numerous visitors as access is improved.

About fifteen kilometers south of Massawa, the village of Hargigo had been a thriving settlement of 16,000-17,000 people in the early 1970's. It was primarily a fishing community. However, with continuous attacks and a terrible massacre during the war years, the population was reduced by over 80%. A pier remains at the shoreline; roads and a few buildings have been left standing. Most of the people are in temporary housing. The government has promised to help rebuild the village and there is apparently a consistent and plentiful supply of water from several wells located in the nearby wadi.

The town of Massawa is the oldest urban settlement in Eritrea. In the early 1960's, the town boasted nearly 80,000 people. Built on two island and the coastal peninsula, it was considered one of the most beautiful Red Sea ports with an imperial palace built by the Turks, spacious Italian coastal villas, and unique architectural influences throughout the town reflecting its diverse past. However, with thirty years of war, including a six-month long bombardment in 1991, the town suffered tragic losses. Massawa's population was reduced to about 22,000 people. Major damage was caused to the town's housing, roads, water and electricity systems, hospitals, and schools.

The town of Massawa is slowly being rebuilt. However, there are significant environmental problems that are persistent. Sewage is currently going into cesspools and septic tanks with limited pumpout being done. There are many areas where sewage is being discharged directly into the sea. Solid waste is dumped into a coastal landfill that is being pushed directly into the sea. Directly adjacent to this landfill is a slaughterhouse that also discharges directly into the sea.

Currently there are four major industrial activities in the area, the port, two fuel depots, the salt works, and the cement factory. The port was once the largest port of the country. However it was also severely damaged by the war, and the port of Assab was built up by the Ethiopians as described above. Jetties, storage warehouses, berths, and other basic port infrastructure was destroyed or severely damaged during the many bombardments on the city. The Port Authority plans to rebuild the port and expand the container terminal, build warehouses, cold storage facilities, and a marshalling yard for transhipment of goods to trucks for transport to Eritrea and northern Ethiopia. However, the master plan for the rebuilding and expansion of the port is not consistent and coordinated with the current master plan for the redevelopment and expansion of the town of Massawa. Data for the port of Massawa indicate that the number of ships has increased significantly from 1992 to 1993. The characteristics of the cargo has changed considerably over this time as well. General cargo data comparing the first half of 1992 to the first half of 1993 are shown below in Table 3-5:

Table 3-5 Comparative statistics of Massawa Port in the first half of 1992 and the first half of 1993

Type	1st half 1993	1st half 1992	Variance amt	Variance %
Ships:				
Dry cargo	86	68	+18	+26.5
Tankers	22	12	+10	+83.3
Passenger	25	16	+9	+56.3
Warships	2	0	+2	+100.0
TOTAL	135	96	+39	+40.6
Cargo handled (tons)				
Discharged:				
Dry	124,992.783	141,028.895	-16,036.112	-11.4
Fuel oil	52,104.434	32,133.476	+19,970.958	+62.2
Subtotal	177,097.217	173,162.371	+3,934.846	+2.3
Loaded Cargo				
Dry	4,517.349	6,727.130	-2,210.130	-32.9
Subtotal	4,517.349	6,727.130	-2,210.130	-32.9
Discharged and loaded				
Dry	129,510.132	147,756.025	-18,245.893	-12.4
Fuel oil	52,104.434	32,133.476	+19,970.958	+62.2
TOTAL	181,614.566	179,899.501	+1,725.065	+1.0
Passengers				
In	1,789	3,024	-1,235	-40.8
Out	1,523	2,618	-1,095	-41.8
TOTAL	3,312	5,642	-2,330	-41.3
Cargo delivered (tons)	161,594.949	175,484.872	-13,889.923	-7.9
Trucks deployed	10,762	11,189	-427	-3.8

(Ports and Maritime Transportation Authority 1993b)

At the AGIP fuel depot, and the Mobil fuel depot nearby Massawa, off loading of petroleum products is done without the benefit of oil spill prevention equipment. No oil spill response and cleanup plan, equipment, or trained personnel are available. This is a growing concern considering the increase in fuel oil imports coming into Massawa. The AGIP fuel depot has its loading jetty extending out through an extensive stand of mangrove. Besides the dredge and fill operation that was necessary during construction of the jetty, there was no evidence of oil seen in the mangrove area. As a whole, the mangrove appeared to be healthy and reproducing.

There are over 4,400 hectares of salt production ponds along nearly eleven kilometers of coastline in and around Massawa extending six kilometers to the south and five kilometers to the north. Because of damage done to the salt factory during the war, only 25% of the ponds are in operation. At its peak, between 90,000 and 130,000 tons of salt were produced each year. Now, production is down to 40,000 tons per

year. The water quality is checked as the water is let into the ponds in the initial stage of production. Salt company officials reported that they have had to reject some water in the past due to petroleum contamination. No heavy metal contamination has been reported.

North of Massawa town is the large cement factory and quarry area. It currently supplies cement for the whole country. Nearly 8,000 tons of limestone/clay substrate is quarried in an area directly adjacent to the plant on the coast. The quarried area extends several kilometers along the shoreline, and to within 10 meters of the water's edge. Vegetation has been slow to recover in the quarried area, though this is to be expected considering the drought and lack of a revegetation program. Because of the low energy coastal waters with low wind and surf, coastal erosion does not appear to be a problem. The plan is to expand the plant by about 40% in the next two years to try to meet the high demand for cement. The quarry should supply enough raw material for the next ten years. At that point, another quarry operation is being considered further inland.

North of the cement factory and quarry area is the tourism beach area called Ghurguzzum. This consists of one operating hotel, and one under reconstruction. More tourism developments are being proposed for this area. The hotels are directly on the beach and run the risk of experiencing damage from the infrequent storms and high surf, such as the one that occurred in April 1993. Solid waste is either buried in a nearby small landfill, or brought to the larger landfill near Massawa. Sewage is gathered in cesspools or septic tanks. Though they are intended to be pumped out, no trucks are available at this time to do this. No water quality data is available to determine if any leaching into the coastal waters occurs.

North of Massawa, there is little if any inhabitation on the coast. There is a proposal, however, that returning refugees from Sudan may be resettled along the coast in the Sahel area in three new fishing villages (MMR 1993d). Similarly the entire coastal lowland plain is considered high in potential for agricultural development if water is developed. If this does occur, then it will be necessary to deal with the concerns about soil runoff, with agro-chemicals attached to the soil particles. Currently soil runoff only occurs during heavy rains in the highland that flood the wadis and eventually discharge into the sea. The Ministry of Agriculture plans to construct retention dams to prevent loss of this water and topsoil.

3.4.3 Southern Islands

There are a few small islands offshore the Dankalia province in southern Eritrea, Halib Island being the largest among them. The coral reefs were reported to have low species diversity in fish and corals (McClanahan 1993). The water visibility is also reported to be low. On the other hand, the mangrove habitat on Halib Island is

reported to have great potential for production and productivity. Though it primarily consists of *Avicennia marina*, the intraspecific variability is high (Mahalingham 1993).

The human uses of these islands is concentrated on Halib Island. The other nearby islands are reported to be uninhabited. There is a large boat building facility built there by the Koreans some years ago, but it is no longer in operation. The Eritrean Navy is considering some plans for getting it in production again, or putting it to some other marine industry related use. Certain mangrove areas of Halib Island have been cleared or affected by road construction, boat construction and repair, garbage dumping, and other human activities (Mahalingham 1993).

3.4.4 Dahlak Islands Archipelago

Offshore the central Eritrean coast, over 350 islands form the Dahlak Islands Archipelago. The islands are arid and consist of rocky scrub desert, with some mangroves and salt marshes. The islands are surrounded by a much larger area of coral reef, seagrass, and sandy bottom environment on a shallow shelf that stretches 30 km offshore in the south, nearly 100 km in the center, and 15 km offshore in the north. Also at the northern boundary of the Dahlak Bank is Saunders Reef.

As with the rest of the Red Sea, this ecosystem has a high level of endemism compared to other oceanic bodies. Approximately 1,000 species of fish and 220 species of coral are found here. Specific surveys report a biodiversity of coral reef fish ranging from nearly 40 species in 24 families on stressed coral formations near Massawa, to over 250 species in at least 49 families on outer coral reef patches near the edge of the Dahlak Bank (Clark 1993).

This very characteristic of high endemism, and the isolation from other water bodies that caused it, along with heavy shipping traffic, offshore oil and gas development, and increasing fishing pressure combine to make the Red Sea, and the Dahlak Islands area very susceptible to loss of species.

Officials report that only four islands are inhabited. These are Dahlak Kebir, Nora, Dohul and Dissei. There is evidence that Dahlak Kebir, the largest island, and perhaps some of the other islands, supported many more people than live there today. The ancient town of Dahlak Kebir flourished during the Axumite Empire. Dahlak Kebir is also the site of a major naval base, originally built by the Soviets, now operated by the Eritrean Navy. Numerous boats, engines, dilapidated trucks, tanks, and barrels of oil and other unknown substances litter the jetty area on Dahlak across from Nocra Island Naval Base. Considerable seepage of petroleum and potentially toxic chemical wastes may have occurred already, though quantities are unknown. The extent of military activities on the many uninhabited islands is also unknown.

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The island villages on these four islands depend for the most part, on the sea for their food. Some of them are also merchants, engaging in trade with neighboring countries, primarily Yemen. The housing is simple. Sewage and solid waste is being disposed of in pits and buried. No ground water quality problems have been reported.

The reef areas surrounding these inhabited islands show evidence of heavy fishing pressure with low number of individuals and species of fish, most of which were small, as well as high degree of algal cover in the reef area. Around the other uninhabited islands, the vast majority of those in this archipelago, the coral reefs are reported to be pristine. Some areas were noted to have a high diversity of fish, but low diversity of corals. This may be due in part to turbidity caused by wind waves causing suspension of sand from the large areas of sandy bottom. Areas experiencing high turbidity were also noted to have less seagrass habitat (McClanahan 1993).

There are many areas of rich seagrass habitat throughout the archipelago, and they are sometimes associated with mangrove habitat on the adjacent nearshore area. Mahalingham (1993) reports that *Trochus erythreus* (a small top shell), *Nerita sp.* (slipper winkle), *Strombus tricornis* (conch shell), and *Cypraea turdus* (cowrie) were all common in seagrass areas. Mangroves are found on some of the larger islands and primarily consist of one species *Avicennia marina*. Some other species are also found, but reported in less abundance, including *Rhizophora mucronata* and *Bruguierra gymnorhiza*. Nesting and roosting birds are found in these mangroves including egrets, pelicans, vultures, curlew and redshank.

Harvesting and conversion of mangrove forests is reported to be minimal along the coastline and the islands. Two areas were noted as having been affected: certain areas of Halib Island have been cleared or affected by boat and road construction, garbage dumping, and other activities. Near Hargigo, the mangrove had been cut and filled to allow for the construction of the AGIP fuel jetty. Mahalingham (1993) reports that some traditional uses of mangrove do occur, though at a small and localized level. These uses include fuel, fodder, house building and boat construction, and medicine. In addition, domestic animals including camels and goats feed on mangrove tree leaves. Other coastal and marine flora used by the local coastal and island villagers include the use of seaweeds *Sargassum* and *Turbinaria* for building construction and roofing, and burning of dried seaweed as fuel (Mahalingham 1993).

The vegetation on the inhabited islands is very sparse, primarily due to human uses and foraging by introduced species such as camels, goats, and other domestic animals. Gazelles have also been introduced on several islands. Hillman (1993a) describes three terrestrial mammals on the islands, two of which were probably introduced, the House Rat and House Shrew, and the third, the insectivorous bat, is probably naturally occurring. There are one hundred and nine bird species in forty one families recorded on the Dahlak Islands to date. These are mainly aquatic sea and shore birds. There are nine terrestrial reptile species (Hillman 1993a).

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Dugongs, whales and dolphins are found throughout the Dahlak Islands. Fishermen report incidental catch of dugongs of such numbers as to indicate significant populations of this rare species. The rich seagrass beds provide the necessary habitat for sustaining a large population, and low fishing pressure and boat traffic prevent a large loss from incidental catch or collisions with boats. There are three sea turtle species reported in the islands including the green (*Chelonia mydas*), hawksbill (*Eretmochelys imbricata*), and leatherback (*Dermochelys coriacea*) sea turtles (Hillman 1993b).

There is limited tourism to the islands, primarily consisting of day trips from Massawa via a local fishing vessel. These trips are primarily to the smaller uninhabited islands for sunbathing and snorkeling. A few visitors go to Dahlak Kebir and go scuba diving with the Eritrean Diving Association which operates a small accommodation there in conjunction with the Eritrean Navy.

3.4.5 Offshore oil and gas

Exploration of coastal and offshore oil and gas deposits have been carried out since the 1920's, with several significant exploratory projects taking place in the 1960's. Reports were prepared in 1984 and 1985 concerning petroleum potentials in the Eritrean Red Sea and in 1989, BP/IFC and AMOCO/IPL acquired acreage on and offshore of the Eritrean Red Sea. There are indications of oil and gas in several areas as shown in Figure 3-2 on page 3-18 below. A 1993 Eritrean Department of Energy report states that "...all the factors necessary for an attractive potential are at least locally present" and the "...hydrocarbon potential of the Eritrean Red Sea is promising" (DOE 1993a). However the data from past surveys is very limited, these surveys were not systematic, and they did not use the currently available modern advanced techniques in oil exploration. The DOE recommends that

> (1) all data from the different sources should be collected and reassessed; (2) interested companies should be invited and given acreage without the need of presenting new data packages; (3) if companies are reluctant to acquire acreage, then make fresh exploration in new areas, and in areas where the data is not available, or is missing, or incomplete; (4) new exploration must be conducted by experienced companies that have access to modern acquisition and data processing equipment; and (5) the international community must be encouraged to assist in financing the exploration and data processing (DOE 1993).

As a whole, the coastal resources of Eritrea are not heavily utilized or under great stress. Localized problems due to urbanization and poor urban infrastructure are apparent and could get worse as population pressures increase in these urban areas. It must be recognized that the potential exists for rapid development and use of these resources and areas, that could cause environmental quality problems and habitat

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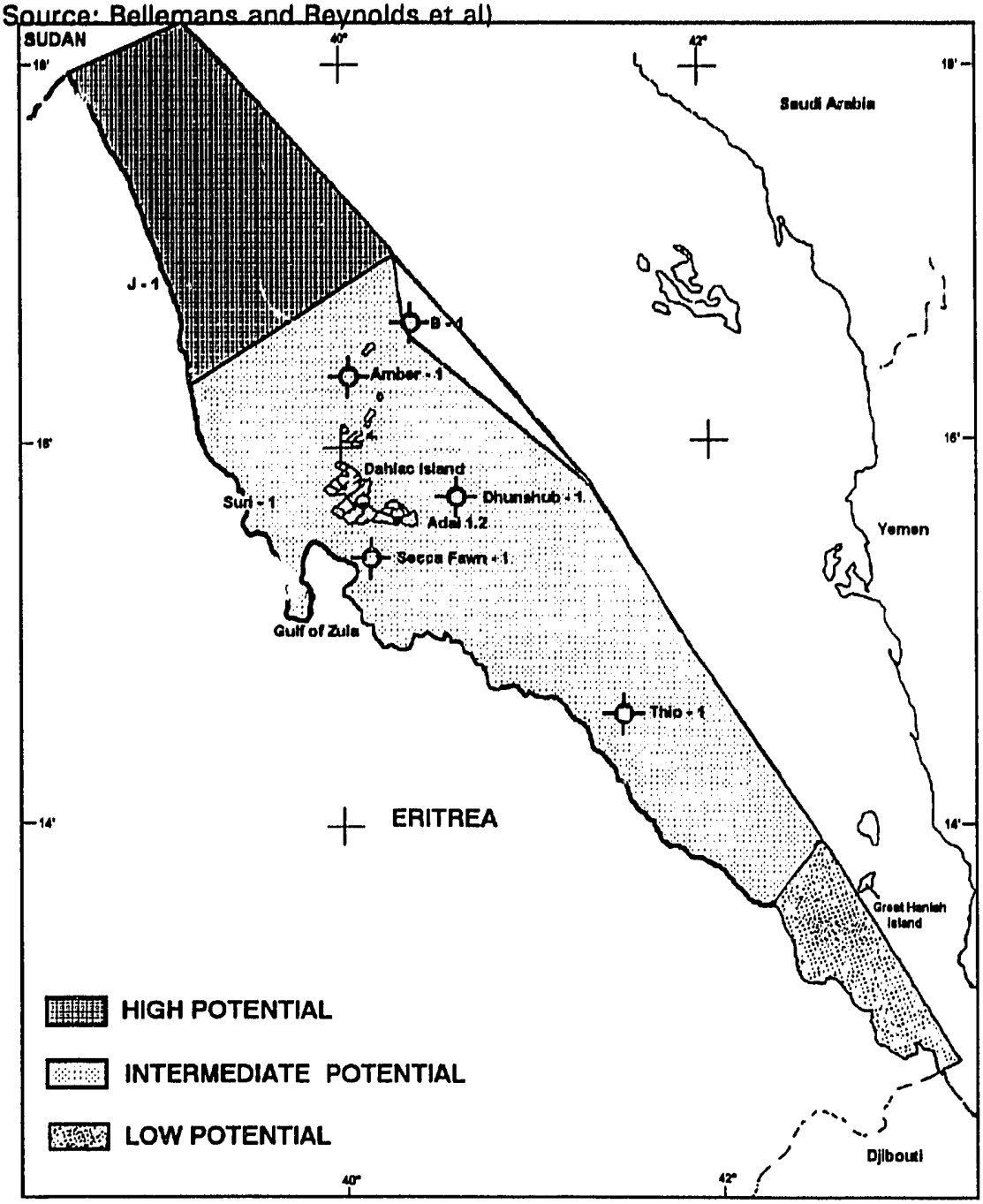
degradation. This degradation could in turn have a detrimental impact on fisheries, tourism potential, public health, and on quality of life.

Figure 3-2 Map of the petroleum potential of the Eritrea Red Sea (DOE 1993)
(Source: Bellemans and Reynolds et al)



City of Asmara

Rural area near Hargigo

4.0 CONSTRAINTS ON AND OPPORTUNITIES FOR THE SUSTAINABLE DEVELOPMENT OF ERITREAN COASTAL AND MARINE RESOURCES

There are constraints on and opportunities for the sustainable development of Eritrean coastal and marine resources. At the beginning of this discussion, however, it is important that we emphasize the concept of *sustainable* development when discussing constraints and opportunities rather than considering unrestricted options which may produce immediate, but short run economic gains which are actually detrimental to future development. To take an extreme example, it can be noted that Eritrea could achieve a rapid and dramatic expansion of its fishery yields and perhaps earn substantial quantities of foreign exchange by sharing in the returns earned by foreign trawlers which could be allowed to enter its territorial waters to harvest its fish stocks. However, this may not generate a sustainable form of development of its marine fishery resources. In view of the limited knowledge that Eritrean officials have of their fishery resources; the country's limited capacity to provide adequate monitoring, surveillance, and control over the fishing activities; and the catch capacity and potentially destructive nature of modern fishing technologies (e.g., modern trawling, use of monofilament gill nets, etc.); it is likely that such a strategy of intense fishing (including trawling and monofilament gear) would seriously undermine the long run sustainability of Eritrea's marine fishery resources. Similarly, a strategy of seeking the most rapid tourism developments in Eritrea's extensive, but fragile coral reef environments could lead to long-term destruction of future opportunities for sustainable and environmentally sound tourism developments. Hence, we must carefully distinguish between development opportunities and *sustainable* development opportunities, as well as between development constraints and *sustainable* development constraints. To the short-sighted, the concept of sustainability itself may be seen as a limiting constraint on rapid development.

This difference between development and sustainable development becomes highlighted when one sees that there are constraints on development which generate opportunities for sustainable development. For example, Eritrea's debilitated artisanal fishing industry which is a constraint on its rapid development may prove to be an opportunity for developing these resources in a sustainable manner. During the immediate period, when the rapid development of its fishing resources is limited and constrained, Eritrea is permitted the opportunity to develop the infrastructure and institutional and human capital capacity to establish a well managed, sustainable artisanal fishery. Similarly, the lack of water, power, and other infrastructure on the islands in the Dahlak Islands Archipelago gives Eritrea adequate time to develop the necessary infrastructure, coastal resource management plan, and institutional framework to support environmentally appropriate tourism development in the area. This discussion is not meant to imply that Eritrea is fortunate to have had its entire economy, environment, and infrastructure devastated by 30 years of war, for the very opposite is the case, but only that planning for sustainable development presents different challenges than does planning for unsustainable development. In the

following, we will focus principally on sustainable development rather than immediate development at the expense of sustainability.

4.1 General constraints and opportunities on sustainable coastal and marine resource development

The most serious constraint on sustainable development of Eritrea's coastal and marine resources is the general debilitated condition of every sector of the economy, due to the long war for liberation. Eritrea faces all of the normal constraints on economic development that are faced by other very poor countries--e.g., lack of infrastructure, human capital, credit, foreign exchange, and so forth. However, during the war, Eritrea's factories were systematically destroyed or dismantled and shipped away, its roads and rail and communications systems were targeted for destruction, its forests were burned, housed bombed, and water wells destroyed. Tens of thousands of its people escaped the country as refugees, and many more fled when they had the opportunity, simply to avoid the ravages of war. While many of its most skilled and educated people left the country, a generation of young people went uneducated and untrained in arts, crafts, skills, and trades that are necessary to sustain the normal economic life of society, whatever the level of economic development. That Eritrea is among the poorest countries of the world would normally be an overriding constraint on its development. However, that Eritrea is recovering and rebuilding from a long and most devastating war must serve as a yet more serious constraint on all development efforts. Eritrea's coastal and marine resource sector, similar to every other sector, is not in an ordinary situation.

As this relates to the coastal and marine sector, a few examples may illustrate the serious difficulties that are faced for the immediate future. Massawa, the major northern port city which was the source of supply for all internationally purchased goods for northern Eritrea and Ethiopia, had a population of about 80,000 in the 1960s, but now has an estimated 22,000 people. Almost every structure in the city suffered war damage if it wasn't fully destroyed. Massawa's water, sewage, and power systems are just being reestablished, and are functioning at minimal levels. The one ice plant for the city, which also supplies ice for fishermen who supply fish to Massawa and Asmara, contains a small, ancient, dilapidated freon block ice producing machine which is kept functioning by an able technician who single-handedly keeps it running by reusing old parts. Fishermen working out of Assab are now doing only day-fishing, since there is no ice available for fishermen. Although the Assab Fishing Center has about 185 boats listed in its registry, only 15-20 boats are credited with landing fish in their fish landing records over the past 7-8 months. Restaurant operators in Assab informed the team that fish was available irregularly, and then only in seriously inadequate quantities. When the head of the central bank, with headquarters in Asmara, was asked about credit for loans to fishermen, our team was told that the banking system and its regulations were just being reestablished. He said that the bank was trying to facilitate the making of loans and the advancing

of credit to those who could show reason for being given priority, but the process of making loans had not been regularized. He said he hoped that the central bank would be functioning "normally" within another six months, and next they would turn to getting a regular commercial bank and the insurance system working before they turned to the savings and housing banking system. Our team was assisted in its work by two recent University of Asmara Marine Science graduates, but were informed that they were the only two Eritreans in their class, the rest being Ethiopians. The Marine Science Department now has about 30 students entering their third year of studies, however, it is now apparent that the university will not hold classes this fall because of financial constraints. Development in the near term operates in the context of serious constraints.

Another aspect of general constraints on coastal and marine resource development in the immediate period is the fact that a new country is being created. The social and political order is being recreated. Legal frameworks are being created and laws are still being drafted for every sector of the country. The Ministry of Marine Resources is a newly created entity. The FAO/TCP project assisted the Ministry in the preparation of draft fisheries legislation, but the draft legislation has still not been finally approved. The development of fishery regulations and resource management procedures are still several steps and many months away. The head of the Port Authority informed the team that Eritrea was still negotiating with the International Maritime Organization about becoming a member and had yet to establish basic legislation and regulations for the port. The head of the Department of Tourism was still in the process of planning how to begin the creation of a master plan for tourism development. The institutional framework which is normally taken for granted by most people in most societies is only now being established in Eritrea. Decisions about most activities are still being made on an almost ad hoc basis.

There are, however, several positive features of this rather dire situation in Eritrea. For example, there is no entrenched bureaucracy which is nearly impossible to alter, nor a set way of doing things which is difficult to change. Various Ministry and Department heads appeared to be willing to cooperate with each other in working out solutions to potential conflicts. Virtually all individuals the team met, including government officials, were exceedingly open and willing to discuss potentials for change and development. There is a high degree of civic optimism, even enthusiasm, among government officials and ordinary fishermen regarding the bright future and development prospects for Eritrea. Winning a war for independence is clearly a positive influence on civic pride and responsibility.

One particularly important positive aspect in the general attitude of the country is the apparent widespread interest in protecting the environment. After being confronted with concern for the environment by government officials, ministry staff personnel, fishermen, and people in the fish marketing business, the team members questioned several people about the source of this intense interest in environmental issues. The

response to the question, repeatedly, was that they had all seen much of their environment destroyed by the terrible war and, hence, were made aware of how important it was to rehabilitate, and preserve, their environment. This environmental awareness in a rather resource-poor country is in striking contrast to many countries where environmental issues are often shunted aside as emphasis is put narrowly on production. The Ministry of Marine Resources, along with other ministries, has already drafted an Environmental Action Plan, and the Ministry of Finance and Development is in the process of organizing a government-wide environmental forum. This conference was initially scheduled for a few months prior to the team's arrival in Eritrea, but had to be put off for a variety of reasons, and is currently rescheduled for early 1994. It is quite clear that the rebuilding of Eritrea is taking place in the context of an impressive environmental awareness by all sectors of the economy and at all levels of society.

4.2 Constraints on and opportunities for sustainable fisheries development

The Red Sea fishery resources are perhaps Eritrea's most important coastal and marine resource. For this reason, the RDA Team has given the sustainable development of Eritrea's fisheries special attention. However, the division is somewhat artificial. Sustainable fisheries development is intertwined with the sustainable development of the Eritrean coastal area's urban, industrial, agricultural, shipping, and, in particular, tourism resources. In the coastal region, these activities share a common habitat, a common environment. Nonetheless, we will follow the accepted practice of examining fisheries separately here and throughout this report, drawing linkages and interrelationships where appropriate.

The FAO/TCP Project identified the constraints on Eritrean fisheries development under three categories: institutional, planning, and management constraints; constraints to productive capabilities; and post-harvest constraints in the areas of distribution, marketing, and consumer orientation. (Reynolds *et al.* 1993b) We shall examine these constraints as our starting point.

The FAO/TCP Project itself addressed the institutional, planning, and management constraints by presenting a sector review, a proposed national fisheries strategy and development programme (reviewed below in section 5.0), and six detailed sector studies. The reports provide a wealth of information on the known status of the fishery sector, including, among other things, a full review of the sector; historical analyses of the fisheries resources; and a frame survey of the current status of the numbers of fishermen, numbers and conditions of boats and gear, catch rates, and costs of production.

Our team benefitted greatly from the accumulation of information contained in these reports. However, neither the FAO/TCP Project nor any other international donor assistance has yet to address the most serious institutional, planning, and

management constraints identified by the FAO/TCP Project. These constraints are first, the need for "institutional development and personnel training" in the MMR itself, and second, the need for "systematic stock assessment/estimate work ... urgently needed to provide fisheries planners and managers with more reliable quantitative indications of the overall situation (Reynolds *et al.* 1993b)." We agree with the FAO/TCP Project team that the lack of a stock assessment and management system and the accompanying staff training necessary to ensure the quality and maintenance of that system is the most serious constraint on the sustainable development of the fishery sector.

The second major set of constraints identified by the FAO/TCP Project, the constraints to productive capabilities, included an array of items, from the scarcity and poor condition of equipment and gear, to the depressed production and producer prices, to the lack of water and infrastructure constraints on aquaculture and inland fisheries development, to the lack of roads and other infrastructural facilities and fishing community services and amenities. The constraints on the productive capabilities of the fishing industry in Eritrea should be rather obvious following the review of the status of the industry in section 3.0 above. Some of these constraints, such as the lack of adequate roads or refrigeration along the hundreds of kilometers of coastline between Massawa and Assab, or the lack of water availability for aquaculture development, will be impossible to address in the short run, as they are related to the general low level of economic development in Eritrea. On the other hand, the constraints such as the poor condition and availability of gear and the lack of infrastructure are being addressed by the UNDP and UNCDF Semhar Projects in the Massawa and Assab areas, by an approved Italian project and a pending Japanese proposal, and by several NGO proposals (all reviewed in section 6.0 below). In fact, it is the view of our team that the Eritrean institutions could probably not presently absorb more technical assistance in the area of improving productive capabilities than it now already has available. The productive capacity of the fishing sector, at least in the major Red Sea areas, is currently in the process of being rehabilitated.

The third major category of constraint on Eritrea's fisheries development, as identified by the FAO/TCP Project, is related to post-harvest needs, namely, the absence of storage and transportation facilities, an inflexible pricing system being used by the government in its attempt to restore a fish marketing system, the absence of organized marketing networks for international fish exports, and a rather narrow domestic market where fish have not been available to become integrated into the traditional diets of most people outside of the major urban centers. The UNDP and UNCDF Semhar Projects in the Massawa and Assab areas and related projects are providing assistance in developing the fish storage and transportation facilities, Several large investments in refrigeration, ice production, storage facilities, and trucks for transporting fish to market are planned. The government is working with the private sector in Massawa, Asmara, and Assab, as well as being directly involved, in trying to reestablish the marketing framework. There are even some small efforts at

introducing Eritrean consumers to the use of fish in their diets. With these projects underway, it is too early to assess what additional assistance will be required in the future to further alleviate these post-harvest constraints.

This brief review of the constraints on sustainable fisheries resource development in Eritrea's Red Sea fishery suggests that the principal unaddressed constraint on the sustainability of these resources in Eritrea is the lack of the ability to manage these resources. There is no stock assessment system, no catch monitoring system, no fishery information system, and no fishery data analysis capability in place, nor is there any international donor assistance directed to alleviating this constraint. The MMR is a new ministry which has able but very limited qualified staff. There is no system in place to guide MMR policy makers and no supporting framework of regulations or management regime. Regulations, guidelines, and policy must be made ad hoc and must be based on very little information to the fishery resources. While it is not unreasonable to direct early attention on alleviating the production and marketing constraints on fisheries development, without due attention being paid to establishing a stock assessment regime, fishery monitoring and information system and management structure for these fisheries resources, these development efforts could in only a few years cause a great deal of harm to the sustainability of the fishery resources.

On the other hand, there are many opportunities for rapid development of Eritrea's fishery resources. Having been relatively under-exploited for a generation, the fishery is likely to have ample stocks of fish, including larger, older fish. Catch rates per unit effort are and will likely remain relatively high for some time. However, as the production and marketing system becomes reestablished and fishing activity resumes on an active level, catch rates will begin to fall. As these catch rates begin to fall, fishers can be expected to increase the intensity of their fishing, improve their equipment and gear, use more and more destructive fishing techniques, and fish down stocks in every corner of their fishery, leaving no areas free from heavy fishing effort. Such a process can actually occur rather speedily, being a matter of years, not decades. In the process there is likely to be increasing damage to the shallower corals, undermining their value in the alternative use of tourism development. Furthermore, without regulations and restraints on the fishery, which, of course, must be based on sound information and analysis, there is likely to be increasing pressure to allow trawling in areas where trawling will have unfortunate environmental impacts. In need of foreign exchange, Eritrean policy makers will be increasingly tempted to allow foreign trawlers to exploit their fishery. Without proper limitations on these trawling activities, the sustainable artisinal fishery could be seriously undermined. Good fishery information and good management needs to be established before, not after, the fishery is destroyed. The best time to establish a fishery information, monitoring, and management system is as soon as possible. There is an opportunity now open to establish a fishery information and management system which could

preserve and protect Eritrea's Red Sea fishery, sustaining its yields and providing employment for today and for the next generation.

While developing a sustainable artisanal fishery is of utmost importance, it is also worth noting that in addition to its opportunities for artisanal fisheries development, Eritrea also has a viable, if modest, opportunity to develop its trawl fishery. As noted above, however, without adequate information, trawling effort can not be rationally managed. For both fisheries there is substantial opportunity for development, not only for home consumption, but for earning foreign exchange from exports to regional markets, and in the longer run, to European markets.

4.3 Constraints on and opportunities for sustainable coastal resources development

Recovering, as it will, from the ravages of a generation of war, Eritrea faces many opportunities for development of its urban and industrial resource base. As its urban centers develop, however, it is in great need of developing a coastal resources plan which can link these urban and industrial developments to the sustained health of its coastal resources. Sustainable coastal resource development is and will continue to be constrained by unplanned and unregulated urban and industrial developments.

As with fisheries, general policies and legislation is needed for integrated coastal resources management in Eritrea. At a more practical level, there is an overall lack of trained urban and regional planners in the national ministries of provincial administration, of finance and development. There are virtually no trained planners at the provincial or municipal level. There are none that are experienced specifically in coastal resources planning. Though there is a coastal zone management (CZM) department or section in the MMR, no one is currently filling the designated CZM position. In general, any development project that is proposed for the coastal, island, or marine environment will need to be reviewed by the MMR to evaluate its potential environmental impact. In turn, the MMR is to recommend conditions for minimizing negative impacts of this development. However, there are no established guidelines for this evaluation or these conditions.

In the face of such constraints, the opportunity is here in Eritrea, to develop policy guidelines for integrated coastal resources management that can be incorporated into each different sectoral plan. Intersectoral and interministry coordination is significantly easier here than in other developing countries that have entrenched bureaucracies. Since the major master plans are just now being developed for the reconstruction of Massawa and Hargigo, the development of industries and tourism elsewhere on the coast, and the plans for tourism and a marine resources management plan for the archipelago, the opportunity is very clear for the incorporation of coastal management measures at this early stage. Fewer conflicts and environmental problems will be experienced in the future with these policies, development guidelines, and review procedures in place.

4.4 Constraints on and opportunities for establishment of a regional marine resources management area

The first constraint facing the MMR in the establishment of a regional marine resources management area is defining what exactly is meant by a "marine resources management area." As a practical resource management tool, a marine resources management area must cover the entire marine ecosystem in that target area, so it needs to be large. It also must allow for the variety of consumptive and nonconsumptive uses within its boundaries, which are managed by a multiple use management plan. The marine resources management area serves to protect fish replenishment areas to help sustain the fishery. It manages tourism, fishing, oil and gas development, and other uses so they are also sustainable and compatible.

Selecting which areas are most effective as fish replenishment areas is a difficult task. There must be clear justification for setting aside reserve areas where fishing is not allowed. To make this selection, information must be gathered through aerial and boat work. Communities must be involved in this process too. It must be a deliberate, well-planned effort.

If tourism is to be developed as a sustainable use of the Dahlak Islands Archipelago area, it must face certain constraints. Eritrea is blessed with an abundance of some of the most pristine and most beautiful marine environments in the world. The tourism development potential is currently constrained largely by inaccessibility, the lack of infrastructure, the lack of water on most of the islands in the Dahlak Islands Archipelago, and the lack of hotel and tourism facilities throughout the region. On the other hand, private investment is likely to become available for the development of the infrastructure and tourism facilities if Eritrea can ensure the sustainability of its pristine reef environments.

The development of a regional multiple use marine resources management plan, and an integrated coastal resources management plan, to protect those resources will create an environment conducive to the private development and sustainable exploitation of these resources. This work is to be done in close collaboration with the UNDP Global Environment Facility, which is planning to conduct a baseline inventory study of Eritrea's Red Sea habitats. Building on this effort and creating protected areas within a marine resources management area to ensure the sustainability of some of Eritrea's unique marine environments will provide a base level of protection of biodiversity as well as the development of a sustainable tourism industry for the Dahlak Islands.

5.0 COASTAL AND MARINE RESOURCES DEVELOPMENT STRATEGY

This section presents a discussion of the coastal and marine resources development strategy that is being crafted in Eritrea. It includes a review of the Ministry of Marine Resources strategy and the United Nations Food and Agriculture Organization recommended fisheries development strategy.

5.1 Ministry of Marine Resources Strategy for Sustainable Development of Coastal and Marine Resources

Coastal and marine resources are playing an important role in the building of the Eritrean nation. As the government continues to define its administrative structure, it is instructive to note that marine resources is viewed as a priority area that has been given the rank of a ministry. What was a Department of Marine Resources and Inland Fisheries (DMRIF) only a few months ago, is now the Ministry of Marine Resources (MMR).

5.1.1 Policy objectives and principal concerns

In its discussion paper on *Objectives and Considerations for Protection of the Marine Environment of the Eritrean Red Sea*, the Ministry of Marine Resources states its objective of promoting the exploitation of marine resources in a manner that results in maximum national benefits on a sustainable basis. The first step in this process is identifying and implementing policies that promote this objective.

The MMR has three concerns in this regard: (1) maintaining the biological productivity of the marine resources; (2) balancing development and conservation of marine resources; and (3) protecting those marine resources that are not of direct monetary value.

5.1.1.1 Maintaining biological productivity of the marine resources

The MMR recognizes that "renewable resources must not be exploited to the point where the biological productive capacity of the various fish resources is reduced below the point where production is maximized" (DMRIF 1993a). It argues that biological productivity depends on the growth and reproductive capacity of the fishery resources, and on the productivity of the marine environment itself. The Ministry reasons that the fishery resources, then, can only be exploited to the extent that these growth and reproductive capacities are not reduced.

5.1.1.2 Balancing development and conservation of marine resources

Environmental productivity can be affected by direct contamination of land or sea-based discharges, or indirect impacts of low-level chronic leaching of contaminants,

dumping of solid waste, and habitat destruction by deforestation, coastal erosion, siltation, trawling or anchor damage (DMRIF 1993a). With this in mind, the MMR clearly presents the difficult challenges it faces with competing demands for the same marine resource. It identifies the need for evaluating development proposals in order to balance the benefits of economic development activities and the potential environmental costs that come as a result (DMRIF 1993a).

5.1.1.3 Protecting marine resources not of direct monetary value

In addition, the MMR identifies the concern of protecting those species that are of national and global importance because of their endangered status, including rare marine mammals such as the dugong, and some endangered and threatened sea turtles. The justification for this concern appears to be primarily based on the existence value of these resources, rather than any monetary value. However, the MMR also recognizes that though the economic value of these resources may initially be viewed as insignificant, they may provide a unique basis for nature-based tourism development in the future (DMRIF 1993a).

5.1.2 Action plan for marine environmental protection

The MMR has developed an action plan for marine environmental protection consisting of four steps: (1) develop the capacity to manage marine resources to provide maximum sustainable benefits; (2) address the activities needed to prevent direct pollution of the marine environment; (3) develop the capacity to undertake Integrated Coastal Zone Management in order to guide essential and desirable coastal developments to produce maximum benefits and minimum costs; and (4) address the issues associated with maintaining the biodiversity and health of the marine environment (DMRIF 1993a).

5.1.2.1 Developing the capacity for marine resources management

Management of marine resources, as described in the *Environmental Action Plan for the Marine Sector* (DMRIF 1993b), has two components: (1) management of the physical marine and coastal environment, and (2) management of the living resources.

Management of the physical marine and coastal environment involves dealing with the effects from

> (1) pollution, i.e., contamination by deleterious substances either of terrestrial origin (eg., sewage, pesticides, fertilizer, silt), (2) direct impact on the environment, e.g., sand removal, dredging, landfill and littoral construction (for example development of tourist or port facilities), and destruction of coral reefs, and (3) degradation of marine habitat through

destruction of vegetation such as mangrove swamps and areas of sea grass. (DMRIF 1993b).

The government states that the initiatives of the Ministry of Marine Resources (MMR) will be directed toward achieving two goals regarding marine environmental protection: (1) drafting a *Marine Environmental Protection Act*, and (2) establishing an integrated coastal zone management system.

The *Marine Environmental Protection Act (MEPA)* is to provide the foundation for achieving this sustainable coastal and marine resources development. According to the *Action Plan*, the *MEPA* is to "provide the legal basis for enforcing practices consistent with protecting of the marine environment and maintaining its biological productivity." (DMRIF 1993b). The scope of this *MEPA* would address issues relating to the control of land-based and sea-based sources of pollution, regulation of mining or petroleum extraction activities on the coast and the seabed, and basic procedures and conditions required for development projects that affect the marine environment. This includes port construction; coastal industrial, urban and tourism development; harvesting of mangrove resources; and other potentially consumptive uses of these coastal and marine resources (DMRIF 1993b).

The establishment of a comprehensive and integrated system of coastal management is to ensure proper evaluation of a proposed development activity by assessing all the various direct and indirect impacts it may cause. "National coastal zone development standards" are to be developed to minimize detrimental impacts on the marine environment from such activities (DMRIF 1993b). Coastal resources management is discussed in more detail below.

The *Action Plan* states two primary goals for management of living marine resources. These are (1) management of fisheries and other relevant harvesting activities as is consistent with fisheries policy, and (2) protection of animals of particular susceptibility to population depletion, including all marine mammals, such as dugongs and dolphins, and turtles, and sea birds (DMRIF 1993b).

Fisheries development, per se, is a priority area for Eritrea because it complements agricultural production to address the critical need for achieving food security in the nation. Since animal stocks have been significantly depleted due to the war, the sea offers a rich resource of protein for the Eritrean people.

The MMR seeks to manage fisheries exploitation so that the resources remain at a maximum level of sustainable productivity. To do this, the Ministry states that it will promote or enforce "responsible fishing" methods appropriate for Eritrea. The MMR refers to the *Declaration of the Cancun International Conference on Responsible Fishing* for guidance in defining "responsible fishing." In general, it is meant to refer

to "fishing practices that have little or no impact on animals other than the target species" (DMRIF 1993a).

Which responsible fishing methods are appropriate for Eritrea remains to be determined. However, trawling, gill net, and hook and line methods are briefly reviewed by the MMR and this gives some indication as to their level of acceptance by the Ministry. Trawling is considered to be "very unselective both in terms of the size of fish that are caught and other incidental animals" (DMRIF 1993a). Catch of juveniles, and nontarget species that are discarded dead or in a highly stressed condition are cited as problems with trawling. Also, gill nets are considered "potentially unselective" even though mesh size can provide a "considerable degree of selection." This is due to the fact that there can be incidental catch of fish with bony protuberances, birds, turtles, and smaller marine mammals, as well as ghost fishing by discarded or lost gill nets. Hook and line fishing is considered by the MMR to be a "highly selective method" with low incidental catch of small fish or non-fish marine fauna. The Ministry notes that "it produces fish of high quality, does not require capital intensive investments for harvesting, and thus it is more cost effective and has a higher labour (and thus employment generating capability) requirement per unit weight of catch landed" (DMRIF 1993a).

In addition to this analysis of fishing techniques, MMR officials consistently state three general goals for national fisheries policy: (1) to increase the supply of fish for domestic consumption; (2) to improve the quality of life and incomes of the local fishers; and (3) to export some fisheries products to generate foreign exchange (Meky 1993).

The *Action Plan* presents a useful discussion and analysis of the factors that are involved in the government's efforts to develop a sustainable fishery. These factors are common ownership of fisheries resources, the effects of uncertainty, and the discounting of future benefits (DMRIF 1993b). The MMR views fisheries as a public common property resource, the benefits of which are to be shared by the public. Therefore, fisheries management must be implemented by equitable application of rules and regulations that do not prevent access by the public to this resource. As a common property, no one person owns it, rather the public as a whole owns it. So, the management of fisheries is to be done by the government, which holds the public trust, and management costs are to be borne by those reaping the resource benefits. The MMR recognizes that instilling a sense of stewardship on the part of an individual for such a public resource is also a challenge.

The effects of uncertainty are a hard reality to face. Fishery management decisions are always being made with limited data, and the marine ecosystem is so dynamic, it is always uncertain as to the natural changes in fish stocks that would affect catch. With limited data, a manager can develop different scenarios for fisheries development, and assign probabilities for various outcomes. This quantifies the level

of risk associated with that management decision. By knowing this level of risk, the MMR believes that decision makers can evaluate the potential consequences of a management decision and proceed on a more pragmatic basis (DMRIF 1993b).

Discounting future benefits is the third important factor the MMR identifies in developing fishery management policy. For example, the government may allow large-scale commercial operations now, thereby creating a significant increase in catch, employment and income in the short run. However, this option may preclude the maximization of future benefits, that is, the sustaining of present benefits on a continuing basis.

As a result of considering these factors, the MMR notes that it must balance the following factors:

> (1) the need to seek input from all those who will be involved in the fisheries sector, whether they are well organized now and so able to articulate their views or have yet to determine what their needs are, (2) the compromise between forgoing immediate benefits by proceeding with caution in the presence of major uncertainty about the parameters determining the productivity of our marine resources, and (3) the essential requirement of deciding on, and installing the appropriate management mechanisms to enable optimal management of our marine resources (DMRIF 1993b).

Regarding the second goal of protecting "animals of particular susceptibility to population depletion," the *Action Plan* identifies the first step to undertake is a "comprehensive national inventory identifying the relevant populations, their habitats and areas of particular sensitivity" (DMRIF 1993b). The survey would also identify if coastal communities harvest these animals. If harvesting does take place, then "a dialogue should be started to identify ways of reconciling conservation needs with traditional practices" (DMRIF 1993b).

5.1.2.2 Pollution control

Concerning pollution control in the marine environment, the ministry's goal is to

> prevent the contamination of the aquatic (freshwater and marine) environment by any factors that might harm the ecosystems such that their growth, reproductive or carrying capacity is reduced or that could significantly alter the species composition (DMRIF, 1993a, p. 3).

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Various types of pollution are identified as concerns for the MMR, and there is a lack of information about each. The different types of pollution discussed include chemical pollution, sewage, solid waste, and oil pollution,

The short term objective is to "review relevant developments in technical progress and pollution legislation. Based on this review we will formulate policies for controlling pollution and advise on and develop draft legislation" (DMRIF 1993a).

Specific policies of the MMR are stated concerning the different types of pollution, which are instructive to enumerate. For solid waste, the MMR "will support and encourage legislation prohibiting discharge of solid waste by vessels in Eritrean waters" (DMRIF 1993a). The MMR intends to install garbage receptacles at each fish landing site, along with an education campaign to encourage fishers to use them. Merchant vessels "could be required to discharge all garbage ashore in order to get clearance to sail" (DMRIF 1993a). The MMR "will support legislation that will prohibit dumping of materials (rubbish, building debris, cars, appliances, etc.) along, or within a specified distance of the shoreline or dumping into the sea itself (DMRIF 1993a).

For oil pollution, the MMR intends that "Eritrea take a leading role in promoting safer shipping practices in the Red Sea and in the preparation for marine disasters and coordination of emergency response activities" (DMRIF 1993a). The Ministry "as resources allow, will be developing emergency response procedures and undertaking contingency planning for oil spill emergencies. Action will be taken to acquire appropriate equipment and materials for emergency protection of the marine environment and particularly sensitive habitats and areas of rare or endangered species" (DMRIF 1993a). The MMR also plans to install used oil receptacles at each fish landing site along with an educational program to encourage fishers to use them. The Ministry will also "promote adoption of legislation prohibiting the discharge of oil or oil-contaminated water in Eritrean waters" (DMRIF 1993a).

In its report *Energy and the environmental factor*, the Eritrean Department of Energy (DOE) also addresses the environmental impacts of oil released into the marine and coastal environment. It provides a basic assessment of the potential for oil spills from various parts of the petroleum industry, including exploration, production, refining and transportation. The resources at risk are identified, primarily fisheries, coastal resources, and wetlands. The DOE recommends careful implementation of standard oil pollution prevention measures in each step of the petroleum industry. If a spill occurs, DOE identifies several options for response and clean-up, depending on the specific characteristics of the spill. With this in mind, DOE counsels that the response should consider;

> ecological interests (fisheries, wildlife, etc.), the commercial interests (tourism, etc.), the legal interests (plant and oil owner), the financial interests (insurance broker, etc.), plus representatives from the state and

> authorities affected together with technical assistance and advice of specialists trained in clean-up activities. It is important that the decision-making should be professional and flexible (DOE 1993b).

For sewage, the MMR states that it

> will support actions that require coastal shipping (where appropriate) to install sewage treatment equipment on vessels conforming to standards as established by international organizations such as the International Maritime Organization (IMO). Likewise, coastal shipping should be discouraged (prohibited?) from discharging untreated sewage in ports and in other designated areas (DMRIF 1993a).

5.1.2.3 Integrated coastal zone management

Concerning integrated coastal zone management, the MMR objective is that

> all activities undertaken in the coastal zone that result in (significant) change in the environment be subjected to comprehensive evaluation to ensure first, that all externalities are included in the calculation so that the true national costs and benefits are determined, not only those arising as a consequence of the project, and second, that projects which are approved are implemented in a manner that minimizes any impact on the physical or biological environment (DMRIF 1993a).

The need for a comprehensive coastal zone management plan is being considered regarding:

> 1. Existing and future potential renewable resource harvesting activities, principally fisheries and possibly mariculture of, e.g. brine shrimp and seaweeds, and also the traditional industries such as making salt;
> 2. existing and future urban development;
> 3. existing and future small-scale regional development - smaller communities outside of the Massawa/Assab city areas; and
> 4. present and future potential for industrial development (DMRIF 1993a).

A Coastal Zone Management (CZM) Department of the Ministry of Marine Resources is planned. This department could decide if an environmental impact study would be

required of a proposed development. Activities that the MMR expects to be relevant to the CZM Department include, but are not limited to:

1. port development or expansion including dredging;
2. any activity resulting in a change to the shoreline, e.g., infill of estuaries, beaches or mangrove areas;
3. removal of marine sediments or beach materials;
4. any industrial development or agricultural practice in which discharged material will enter the sea (including bays, creeks, mangroves, etc.);
5. sewage discharge by any organization, e.g., municipalities, beach-front hotels, etc.;
6. coastal aquaculture;
7. exploitation of mangroves;
8. recreation, eco-tourism and other relevant tourist activities; and
9. urban expansion into, or adjacent to, coastal wetlands (DMRIF 1993a).

5.1.2.4 Protection of habitats and biodiversity

Concerning protection of marine flora and fauna and maintenance of bio-diversity, MMR has identified as its objective

> to ensure the survival of all the plants and animals that occur in our seas and coastal areas. The basis for this goal is the national value we place on the survival of all the plants and animals that form our national heritage (DMRIF 1993a).

Marine mammals, turtles, birds, and fish are discussed in this context. Efforts to protect the marine environment and prevent pollution, as discussed above in section 5.1.2.1 and 5.1.2.2, will be the tools necessary to protect habitats. Protection of biodiversity also overlaps with the discussion above in section 5.1.2.1 regarding protection of animals of particular susceptibility to population depletion, including all marine mammals, such as dugongs, dolphins, turtles, and sea birds. Integrated coastal zone management is the tool to balance development and conservation to help achieve this objective.

5.1.2.5 Requirements to implement this *Action Plan*

The Ministry of Marine Resources believes that fisheries is in urgent need of rehabilitation. The initial main focus for this rehabilitation effort is the existing net and handline fishery based on the Dahlak Islands. They estimate that the potential

sustainable production of fish from the Semhar area is over 4000 tons, which could support a fishing fleet of about 110 traditional vessels. However, the fleet needs significant assistance in repair and upgrading of engines and gear to achieve this level of production. In addition, there is lack of landing and support facilities, boat handling, repair, maintenance and gear supply facilities, very limited ice production capacity and cold storage and marketing facilities (DMRIF 1993b).

This rehabilitation effort is being carried out through the implementation of various donor-assisted projects. The largest one is the FAO supported project for fisheries rehabilitation in the Semhar province. In addition, there is the Red Seas fisheries project of the Urk Interchurch Foundation, the Manzanar project, and the Assab project. (see section 6.0 for description).

The Ministry of Marine Resources recognizes that there is a critical lack of information that is needed in order to manage these fishery resources on a sustainable basis. First, the biological characteristics of the exploited fish stocks must be determined in order to provide the necessary information for the stock assessment models. Also needed is ongoing monitoring of the resources, fish landings by species, size, stock, fleet sector, and area, along with information on the fishing fleet and their level of fishing effort. The catch and effort information is recommended to be gathered either by fishermen log books or through sampling at landing sites. Personnel are needed to gather the information, enter it into the computer, and analyze the data for management purposes. In addition, a system of fishing licenses is to be instituted. The MMR believes that economic and social data also must be collected on a continuing basis to better determine if any cost-recovery is possible for management efforts. Limited resources of money and personnel are a great concern in this area (DMRIF 1993b).

The Ministry of Marine Resources recognizes the need for formalizing the national fisheries policy and developing methods of regulation. In addition, the country needs to join regional and international agreements regarding protection of the marine environment (DMRIF 1993b). This is discussed below in section 5.2 on FAO recommended strategy.

The Ministry seeks to build its institutional capabilities for management of the fishery and other marine resources, and for managing donor-assistance projects. Training is needed for building a fisheries research capacity, oceanography and marine biology expertise, and coastal environmental survey and management capabilities (DMRIF 1993b).

There is a current proposal by the MMR to establish a provisional committee on marine resources protection that would coordinate interministry efforts in this area. Ministries involved include the Ministry of Marine Resources, Ministry of Defense, Ministry of Trade, Industry and Tourism, Department of Tourism, Ports and Maritime

Transportation Authority, Ministry of Justice, and Ministry of Finance and Development.

The MMR is taking a cautious expansion policy due to lack of information and inability to field trained fishery observers. They are working to encourage and promote Eritrean participation in the fishery to the greatest extent possible, so they are cautiously evaluating the numerous proposals for large industrial scale fishing by foreign countries. The concern is that such a fishery would take away the long term growth opportunity for the local fishing community (DMRIF 1993b).

The Eritrean government is committed to a regional development policy so development will occur in the whole coastal area, not just Massawa and Assab. So the plan is to provide basic infrastructural support for production (fishing gear, ice and cold storage) and transportation of fish products to centers for processing and freezing for export. The MMR seeks to involve local communities in management activities and decision-making, while ensuring that over-exploitation does not occur (DMRIF 1993b).

5.1.2.6 Conclusion

The Ministry of Marine Resources has accomplished a significant amount of comprehensive planning for its strategy for sustainable development of its coastal and marine resources. In addition to the objective of food security and local economic development, the government is strongly committed to resource conservation and management-oriented research. Senior government officials involved with various related aspects of coastal and marine resources development are all articulating the same objectives of sustainable development. This cohesion of policy objectives, comprehensive strategy for development, strong political will, and a cautious approach to resource exploitation are all essential elements in a successful program of sustainable resource development.

The challenge now is to implement these policy objectives through legislation, plans and programs in the face of the significant constraints the MMR is experiencing. It will be important that the MMR be steadfast in this cautious approach to fisheries development, with the strong external pressure to develop the fishery now by issuing permits for foreign trawlers to operate in Eritrean waters.

5.2 FAO Recommended Fisheries Development Strategy for Eritrea

In mid-1992, a team was sent to Eritrea by the United Nations Food and Agriculture Organization (FAO) to assess the situation in the country regarding fisheries development in a project described above as the FAO/TCP project. Clearly, discussions with the FAO team members helped shape the development strategy crafted by the Ministry of Marine Resources described above. The scope of the FAO

project was comprehensive and provides a very useful assessment of the history and current status of the fishery, along with recommendations for its redevelopment.

5.2.1 Fisheries sector study

The technical cooperation program produced a comprehensive sector study examining the marine fisheries in terms of the evolution of artisanal and industrial exploitation activities, current production and capabilities, and socio-economic characteristics. These socio-economic characteristics included occupational patterns, settlements and services, seasonality and migration, patterns of trade, and effort and financial performance of fishing units. Aquaculture and inland fisheries were also examined in terms of production base, current and planned fishing and fish farming activities, and potential for development. Domestic and export marketing issues were analyzed. Legal, institutional, and management concerns were identified. Finally, investment and credit issues regarding fisheries development were noted (Reynolds, et al. 1993a).

5.2.2 National Fisheries Strategy and Development Programme

Based on this sector review, recommendations were made regarding the formulation of an *Eritrean National Fisheries Strategy and Development Programme* (see Reynolds, et al. 1993b). These recommendations were presented and approved in principle by the participants in the National Conference on Fisheries Planning and Development held in Massawa from 30 March to 4 April 1993 (see DMRIF 1993b).

In summary, the strategy states that there is definite potential for restoration or possibly expansion of the marine fisheries production. There is a significant demand for Eritrean fisheries products in regional and overseas markets, and a consistent, albeit limited domestic fisheries market. In addition, there is a favorable investment climate being cultivated by the government in Eritrea (Reynolds, et al. 1993a).

The strategy recognizes various constraints on fisheries development in Eritrea including institutional planning and management capabilities, productive capabilities, distribution, marketing, and consumer habits. The main recommendations focus on:

> Strengthening of fisheries institutions in their capabilities for promoting expanded but carefully planned and managed sustainable use development of the sector.
>
> Developing fisherfolk communities through pronounced enhancement of the productivity and profitability of artisanal fisheries enterprises.
>
> Encouraging domestic consumption of fish and fish products in order to create a sharply increased demand on local markets.

Building up production and trade of fisheries products for export as a means of securing foreign exchange earnings for sector development and the country at large.

The FAO recommended action plan for fisheries is comprehensive and contains short and medium-term measures. These recommendations are in the following areas. First, the FAO recommends strengthening fisheries institutions and services by improving the MMR organization and functions. This would be accomplished by developing core capabilities and collaborative linkages, and by the creation of new department sections. In the short term this could be accomplished by (1) reshuffling personnel so that staff educational and experiential abilities are matched with post responsibilities; (2) establishing regular mechanisms for collaboration and consultation between the MMR and other fishery-related institutions at the national, regional, and international levels; and (3) set up a Fisheries Advisory Council as soon as possible. New department sections that are recommended include Planning and Project Coordination, Resources and Environment, and Production and Marketing. The Planning and Coordination Section would then have the responsibility to chart out, monitor and evaluate the national fisheries development process (Reynolds, et al. 1993b).

FAO recommends that the management capabilities of the MMR need to be improved through passing fisheries legislation, establishing an adequately trained and staffed enforcement program, developing a comprehensive fisheries statistics system, carrying out management-related fisheries and marine resources research, initiating an ongoing training program, and establishing credit facilities for the fishing industry. The legislation needed includes general fisheries legislation, priority regulations, laws concerning fisher cooperatives and associations, and general maritime zone legislation (Reynolds, et al. 1993b).

Enforcement requirements are identified as short to medium term measures and include developing plans for cost-effective monitoring, control and surveillance activities that can be accomplished with existing staff and facilities, and in cooperative arrangements with the Navy, and the Ports and Maritime Transport Authority (Reynolds, et al. 1993b).

FAO considers fisheries statistics as absolutely fundamental to all fisheries planning and management activities, and that substantial work must be done in the short term to address this need. This would include establishing a unit within the MMR with proper equipment and staff to systematically collect, compile, analyze and report data on fisheries catch, socio-economic characteristics, and marketing patterns. Critical tasks that are recommended for this unit include:

establishing standard definitions and usages for technical terms (boat and gear types, etc); conducting frame surveys of the fisheries sector on a regular basis; operating a catch assessment survey (CAS) system covering both marine and freshwater fisheries; conducting ad hoc surveys to determine appropriate weight conversion ratios (processed to fresh weights, e.g.), measure various socio-economic characteristics, and marketing patterns; and monitoring the pattern of fishing pressure and the state of the stocks (Reynolds, et al. 1993b)

Regarding fisheries and marine resources research, FAO recommends that in the short term, the MMR should work to develop the capabilities to do fish stock assessment, monitoring, and other marine resource survey research. Then, the MMR should conduct ad hoc socio-economic investigations of fishing communities, fishing unit operations, fish trading and consumption patterns, as well as formulate a plan for applied research. In the medium term, FAO emphasizes the need to coordinate research efforts with the University of Asmara and other regional and overseas institutions with fisheries and marine resource interests, and maintain a "distinctly practical, problem-solving orientation in all research activities" (Reynolds, et al. 1993b).

Training is emphasized by FAO for two target groups in the short term, young novice fishers and women. In the medium term, MMR should develop its own fisheries training plan. Regarding credit facilities, FAO recommends that, in the short term, the MMR monitor the performance of the revolving fund scheme of the Semhar project, and other credit arrangements for private local fish traders. If successful, the MMR should consider different options such as using the local fisher associations as credit intermediaries, rather than credit scheme managers or administrators; use of loan indexing to maintain the real value of the money being used in the loan programs; and extending credit to the production, processing and marketing activities of women. With this experience, the MMR, with the other relevant ministries and institutions, could then work to establish fisheries credit facilities as part of a normal national banking system (Reynolds, et al. 1993b).

The second area of FAO recommendations are in developing production through specific measures taken regarding production inputs, pricing, private fish buyers, resumption of industrial trawling, use of government revenues for infrastructural development, and aquaculture and inland fisheries. Production input measures are recommended for the short to medium term and include establishing a mechanism for allowing suppliers of these inputs to secure the necessary foreign exchange to import such items; keep customs duties and taxes applied to imported fishing inputs at a minimal level; avoid the sale or distribution of gear and other production inputs at Government or donor-subsidized prices; and organize courses for local fishers and others in handling, maintenance, and repair of equipment (Reynolds et al. 1993b).

FAO also recommends that in the short term, prices should be liberalized, and an early deregulation and free auction buying of fish at the landing sites should be allowed. With this in place, the MMR could then monitor the impact of such measures over the medium term on fishing communities and export flows, and reassess the pricing policy accordingly (Reynolds, et al. 1993b). FAO strongly recommends that after this transitional period in the short to medium term, government avoid involvement in the fish trade as much as possible, and instead encourage private fish buyers to work in the coastal towns and landings. They believe this would result in greater landings of fish products in Eritrea rather than in other regional ports (Reynolds, et al. 1993b).

Over the short to medium term, FAO recommends that the MMR levy modest facility user fees, landing fees and license fees, and use the funds to develop and rehabilitate the basic infrastructure of the landing sites. The MMR should also consider the establishment of a "Fisheries Development Fund" to serve as a mechanism for this purpose (Reynolds et al. 1993b).

The third area is in domestic marketing and consumption, with specific recommendations in distribution and marketing, and efforts to increase consumption. In the short term, FAO recommends that traders be assured of the flexibility to adjust prices in accordance to demand, and to explore new markets. Then, over time, the MMR could promote the steady improvement of infrastructure and services to support fish distribution and marketing. This would include ice plants, roads, communications, refrigerated transport, central holding facilities, and retail outlets. FAO suggests that emphasis should be placed on towns and communities that are not currently served with fresh fish outlets, including the Asmara environs. Promotion of fish consumption needs to be coordinated with other agencies using extension activities in the communities, mass media, and school meal programs (Reynolds, et al. 1993b).

The fourth area of recommendations is in the development of fisheries exports, with specific measures outlined for the artisanal/industrial operations, and for export support services. In the short term, FAO recommends that the MMR "encourage feasibility studies and private initiative to restore specialized fisheries product export enterprises that would produce value-added for Eritrea and establish on-shore facilities and employment opportunities" (Reynolds, et al. 1993b). In the short to medium term, the MMR should "study the possibility of developing modest artisanal and/or industrial (purse seining) capacity for small pelagic fish to supply domestic and regional markets" (Reynolds, et al. 1993b). In addition, a formal set of export procedures needs to be developed covering licensing, movement permits, quality certification and other requirements. Possible arrangements should be explored to earmark a portion of the foreign exchange earned through fish exports for acquisition of production inputs that need to be purchased abroad. Also, policy and procedures for the operation of international and local investor offices must be clarified. Finally, the applicability of certain provisions in the Investment Proclamation (PGE 1991) need

to be reviewed and possibly revised for a clearer delineation of fisheries interests (Reynolds, et al. 1993b).

5.2.3 FAO recommended draft fisheries legislation

A key recommendation regarding building national capability for fisheries management is to finalize and adopt fisheries legislation. To address this, FAO sent a second legal team back to Eritrea in late 1992. In close cooperation with government officials in the relevant ministries, a draft fisheries legislation was developed. The draft legislation includes provisions for administration, fisheries management, fishing licenses, aquaculture, enforcement, and general provisions for appeals and regulation development. Within the administration provisions, the Department of Marine Resources and Inland Fisheries (now MMR) is designated as the department responsible for the management and development of fisheries in the country and administration of the fisheries law. A Fisheries Advisory Council is also created in the draft legislation to advise on the management and development of fisheries composed of a fisheries officer appointed by the Secretary, representatives of the Department of Ports and Maritime Transport, Department of Economic Development and Cooperation, University of Asmara, and at least two persons engaged in fishing (Scovazzi and Christy 1993).

Fisheries management and development plans can be developed using fishery management measures, including closed seasons, closed areas, method and gear restrictions, species and size restrictions, and limited entry arrangements. Concerning information gathering, it is noted that every person engaged in fishing or related activities shall supply such information as is required by an authorized officer. Specific provisions for scientific research, marine mammal protection, and marine reserves are included (Scovazzi and Christy 1993).

The provisions for marine reserves are useful to elaborate here considering the proposal to develop a regional marine resources management plan for the Dahlak Islands Archipelago that includes marine reserves. Under the draft fisheries legislation, fishing may be prohibited or restricted within a marine reserve, and, except with specific written permission from the Secretary, no person shall

> (a) take or destroy any coral or take any shell; (b) dredge or take any sand or gravel; (c) otherwise destroy or disturb the natural habitat; (d) fish contrary to any prohibition or restriction (for the reserve). [12(3)] (Scovazzi and Christy 1993).

Provisions regarding fishing licenses are included in the draft fisheries legislation. Basically, no fishing vessel may be used for fishing, unless licensed or specifically

exempted from this licensing requirement by the Minister of Marine Resources. The licensing provisions cover the nationality of the fishing vessels, fisheries access agreements, foreign fishing vessel licenses, stowage of gear, national fishing licenses, applications for fishing licenses, conditions for fishing licenses, fees and other payments, validity of licenses, and suspension and cancellation of fishing licenses (Scovazzi and Christy 1993).

Part V of the draft legislation is concerned with aquaculture. Any commercial aquaculture operation must have a valid authorization from the Minister. Specific provisions cover conditions of aquaculture authorization, protection of the aquaculture facility, and suspension of operations and closure of the facility (Scovazzi and Christy 1993). Part VI concerns enforcement and has specific provisions regarding powers of authorized officers, hot pursuit, custody of seized goods, disposal of perishable goods, release of vessels, or equipment on bond, offenses (with maximum penalties), liability of the master, forfeiture, cancellation of licenses, presumptions, burden of proof, jurisdiction of the court, and administrative settlement. Part VII covers general provisions regarding appeals and the promulgation of regulations. (Scovazzi and Christy 1993).

Also included in this draft legislation are guidelines for approval of fishing joint ventures and draft fisheries regulations. These regulations cover foreign fishing vessel licenses, national fishing licenses, other licenses, scientific research, and management measures. Draft applications are given for a foreign fishing vessel license and a national fishing vessel license. Draft specifications are given for marking of fishing vessels (Scovazzi and Christy 1993).

The report goes on with general discussion and recommendations concerning marine pollution. Of the different types of marine pollution, the two sources considered of greatest threat to Eritrean marine waters are (1) from ships, and (2) from dumping. FAO recommends that Eritrea either become a party to the International Convention for the Prevention of Pollution from Ships (enacted in London in 1973/ amended in 1979), also called MARPOL; or enact domestic legislation reflecting some of the provisions embodied in MARPOL and in some of its annexes. Regarding pollution from dumping, FAO recommends that Eritrea could either become a party to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and other Matter (enacted in London in 1972), also called the London Dumping Convention; and/or enact domestic legislation prohibiting the dumping of wastes within its territorial sea, on its continental shelf and within its exclusive economic zone (EEZ), if the country decides to claim an EEZ. Finally, the FAO report suggests that Eritrea consider joining in regional and international treaties and protocols regarding the protection of the marine environment, law of the sea, and codification of international law (Scovazzi and Christy 1993).

5.2.4 Conclusions

The FAO recommended fisheries development strategy is a strong foundation for a coordinated effort at building the Eritrean fishery to a sustainable level of production. In the same way, the action plan contains all the elements for a necessary development scheme. The FAO sector reviews are extremely comprehensive and thorough and one can not disagree with neither the needs which are identified nor the strategies which are recommended. However, what is seriously lacking in the report is a prioritization of needs and a long-term step-by-step strategy to deal with the numerous recommendations. With all due respect to the FAO authors, this oversight was most likely a function of the overwhelming magnitude of Eritrea's immediate needs rather than any professional misjudgment.

If there is something missing in the FAO report, it may be in the identification of training needs. It tends to give the impression that most of the needed institutional or artisanal training areas have been covered or are being dealt with by present projects such as the Semhar Red Sea Fisheries Rehabilitation Project. It is true that in-service training opportunities have been offered, but the report fails to stress the need for a continuation of such skill-building training opportunities. With regard to the Semhar Project training objectives, these are specifically targeted for the proposed extension workers, who will then branch out and act as village trainers of fishermen related skills. What is not identified as a training need is the immediate demand skills which will be required to operate all the desired private sector fishery infrastructure needs which have been identified (i.e., ice plants, cold stores, marketing facilities, etc.). Although the Semhar, as well as the Assab, projects allow for technical assistance and potential training within those identified sector needs, in reality the specialists' time will most likely be occupied getting the facilities operational. What little spare time is left will be devoted to training the extension staff. In defense of the present strategy, it is fair to say that these training needs could be satisfied by the existing plan if it were a high priority. Thus, it should be acknowledged that proposed fishery infrastructure operating skills are a definite training need.

Questions were raised at the National Conference on Fisheries Planning and Resources Management regarding the FAO recommendations regarding monitoring, control and surveillance. "It was regarded as premature to embark on devising sophisticated schemes for the time being in view of cost involved with regard to current rent extracted from the Eritrean fisheries" (DMRIF 1993b). The conference also felt that the draft fisheries legislation should be formalized as soon as possible, and the Fishery Advisory Council also be established as soon as possible. These comments reflect a recognition of the current state of the fisheries industry and are reasonable criticisms.

The draft fisheries legislation is comprehensive and provides a useful foundation for management. The regulations are preliminary and additional provisions are required regarding specific fishery management rules as they are developed, such as

regulations for trawling, gear restrictions and other specifications. In addition, the marine reserve provisions need to be broadened to address the multiple-use management necessary in the proposed Dahlak Islands regional marine resources management plan.

Both the Ministry of Marine Resources and FAO identify the key steps in the strategy as strengthening the fish production, distribution and marketing system; doing a stock assessment and establishing a fishery management system; and developing the fishery sector, along with other marine resource use in an environmentally sustainable manner. The next section describes the existing and proposed donor assistance projects and evaluates how they are addressing these strategy requirements.

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6.0 INTERNATIONAL DONOR ASSISTANCE ACTIVITIES, PLANS, AND NEEDS

This section will provide a brief review of past, present, and recently proposed international donor assistance support for developing Eritrea's coastal and marine resources. Following this review, there will be a discussion of the apparent gaps in Eritrea's current portfolio of international donor assistance for coastal and marine resource development.

6.1 A brief history of past international donor assistance to the sector

It is refreshing and positive to report that Eritrea's marine and coastal sector is not without international donor assistance activity. Some previous noteworthy activities include the Lutheran Worldwide Federation (LWF) Massawa/Dahlak Fisheries Project (1983 to 1990), the Rehabilitation of Red Sea Fisheries and Marine Fish Marketing Development Projects in Assab (1988 to 1991), and the Haleb Island Shipbuilding Complex (early 1980's to 1991).

The LWF Massawa/Dahlak Fisheries Project, funded in part by Lutheran Worldwide Federation (LWF), the United Nations High Commission for Refugees (UNHCR), and the Ethiopian Relief and Rehabilitation Committee-Evangelical Church of Eritrea, created the Tewale Boat Yard in Massawa, a landing jetty at Jemhile on Dahlak Island, and introduced the ring net to fishermen. The Tewale Boat Yard was mostly destroyed during the war but is presently the site of the Ministry of Marine Resources cold storage receiving facility in Massawa. The rehabilitation of this site is a major part of future project plans, as described below.

The Rehabilitation of the Red Sea Fisheries and Marine Fish Marketing Development Projects in Assab, under joint UNDP/UNCDF/FAO funding, established a fishery development center, a boat building facility, an ice and cold store facility, a marketing facility, and a fresh and frozen fish delivery system to Addis Ababa. Although most of the facilities are not functioning at present, their rehabilitation is also a major part of future project plans described below.

The Haleb Island Shipbuilding Complex is an extensive boat building complex, built by the Koreans, and since abandoned. The facilities are geared toward fabrication of steel-hulled light industrial fishing craft as well as wooden and fiberglass artisanal boats. Although the complex represents a previous major investment, its future has not been determined as yet. At present, it is being looked after by the Eritrean Navy, and it's operation is being considered by the Ministry of Marine Resources as a training facility and by the Port of Assab as a repair facility.

In late 1992 and early 1993, an FAO/TCP project conducted a comprehensive fisheries sector review of Eritrea. The major objective of the project was to conduct an extensive frame survey of the fish harvesting and marketing sectors as a guide for

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marine and inland fisheries development in the short and medium term. This report draws heavily on the results from that sector review.

6.2 Current and proposed international donor projects in the sector

This section reviews the current and proposed international donor assisted projects in promoting the development of Eritrea's coastal and marine resources.

6.2.1 The Semhar project

The backbone of present and future fishery assistance to Eritrea is the Semhar Project and those additional donor projects which have been redesigned to supplement the goals of this project. The Semhar Project (joint UNCDF/UNDP/FAO funding) in conjunction with the Assab Project is a renewal of the earlier Rehabilitation of the Red Sea Fisheries Project. This project has a five year (5 million $US) multifaceted commitment toward development of the artisanal fisheries sector of Eritrea.

Major planned project areas of activity include: (1) Rehabilitation of the fishing fleet by establishing an "import support fund" for two years, followed by a revolving fund for three years to supply fishermen with boats, engines, gear and repair supplies. (2) Improve the fish landing facilities at Massawa and Dahlak by providing them with marine workshops, fishing gear storage, fuel and water supplies. At Massawa, an ice plant, ice storage and cold storage will also be installed. And pick up trucks fitted with insulated fish containers will be supplied. (3) Improve the social infrastructure by (a) overhauling and restoring the desalination plant at Dahlak; (b) constructing clinics and schools on the islands of Dahlak, Duhel, and Noral; (c) rehabilitate the multipurpose building for use by the fishermen in Massawa; and (d) constructing fish retail shops in Massawa and Asmara. (4) Strengthen the Ministry of Marine Resources (MMR) by (a) establishing a Project Implementation Unit within the MMR with staffing support and consulting specialists in fishing gear technology, socioeconomic aspects, and project monitoring; (b) establish a National Fishery Survey Program to provide a broad spectrum of baseline data on the fisheries sector; and (c) fund a program of in-service and out-of-country training. The training would be for senior MMR officials and project directors, specialists and technicians, fisheries extension training officers, and small scale fishermen and fishing communities. Subject areas would include research and stock assessment, fish capture technology, fish utilization, policy planning and administration, aquaculture, and various environmental issues (UNCDF 1992a).

Funding is being finalized for similar activities to be conducted at the Assab Fishery Complex facilities. This project is being revised and incorporated into the Semhar project for administrative purposes. The original outputs envisioned for the Assab site include: (1) developing a fully-equipped workshop where seventeen houris (traditional fishing boats) could be built and at least fifty houris repaired and maintained annually;

(2) establishing a revolving fund for procurement of boats, engines, gear, and repair parts; (3) establish a training program for trainers and new fishermen; and (4) identify, test, and introduce new and improved fishing gear and techniques to leading fishermen (UNCDF 1986). The other objectives of training and marketing assistance are now covered in the overall Semhar project. With the full implementation of both the Semhar and Assab Projects, the entire artisanal fishery of Eritrea will be initially covered.

6.2.2 The Italian fisheries project

In addition to the Semhar and Assab Projects, there are two other projects (Italian and Japanese donor assistance projects) in the process of finalization which will complement the Semhar/Assab programs. There has been an Italian Government donor commitment (approximately $4.7 million US) which is being redesigned to add fish marketing support to the Semhar Project.

An initial draft proposal describes the outputs as follows: paving the grounds in the Massawa Fishing Center; installing a blast chiller, pre-freezer and 50-ton cold storage facility at Massawa; build a fish processing site/building to house the freezers and storage facilities; build a small quality control laboratory; creating a revolving loan fund for fishermen to purchase boats, gear, and repair parts; develop a wind power generated cold storage, reverse-osmosis desalination plant and fish drying facilities on Dahlak Island; develop inland fish marketing facilities at Asmara, Keren, Ghinda, Dekemhare, and Mendefera; provide a refrigerated truck for transport of fish to these inland markets; provide fish transhipping vessels for transporting fish out of central Eritrean coastal villages; and initiate training of local people in fish processing, refrigeration repair, engine repair and boat repair. This project would require foreign experts working alongside national counterparts (MMR 1993b).

6.2.3 The Japanese fisheries proposal

The Japanese assistance project (which is in final preparation) will supply facilities and equipment for fishing villages and construction of a jetty and fishing complex in Assab. Goals of the Japanese project (US$10 million) will be construction of a major fishing harbor and infrastructure facilities in Assab including a 70 m jetty, causeway, breakwaters, fish market shed, refrigeration complex (ice plant, fish storage, freezer), engine repair shop, fuel and water supply, fishing gear storage, and office space; developing chilled storage facilities, fuel supply sites, water and power facilities at Barasole, Ras Terman and Rahyta, which are three coastal villages between Massawa and Assab; installation of a small workshop with tools at Berasole; providing refrigerated transport trucks for fish export to Ethiopia along with two insulated trucks, two ten-ton fish transport boats, marketing equipment, fish boxes and a service car; provide refrigeration and marine engineer technical assistance; and

providing funds to outfit the fisherman cooperative with boats and gear which will be replaced through a revolving fund (MMR 1993c).

6.2.4 The Urk Interchurch Foundation Red Sea fisheries project

An ongoing nongovernmental organization fishery development project is the Urk Interchurch Foundation Red Sea Fisheries Project which began in 1992. Activities to date include the training of eight local women from the Massawa area to build nets which can be sold to fishermen, and the training of fishermen in fishing techniques on a small donated European multipurpose fishing vessel. The training has been conducted by a Dutch Master Fisherman who has extensive experience in the region and is supported by the project. The project is planned to continue through 1994 and will be expanding the net building operation/training to include net repair; continuing artisanal fishery training; conducting exploratory tuna fishing; and conducting a small stock assessment survey.

This stock assessment survey is proposed to be conducted over a one-year period, with each cruise lasting about 36-48 hours. It will survey three types of set gear (gill nets, long-lines, and traps). Gill nets would be of different mesh sizes, and hooks on the long-lines will be of different sizes, to test the efficiency of different size gear. The traps would have small mesh size to retain all animals entering the trap. Data collected would include fishing effort employed; total weight of catch by species and, where appropriate, by sex; length frequency data by species and, where appropriate, by sex; and length/weight data for individuals of each species and sex. Also otolith and scales would be kept to check on age. Stomach contents, sea surface temperature and sightings of mammals or turtles would be logged. The proposal mentions that scientists from University of Asmara could work on board the ship to do additional hydrographic research. In addition to this survey work, the ship would be allowed to do some experiments in "commercial fishing", simulating a commercial trawling operation to assess success rates. This would be limited to 30-40% of the total survey time and the catch is to be sold on the local markets in a way that does not "provide unfair competition for the private sector." The research design for data analysis, preparation of data bases, and report preparation are outlined in a general manner. This survey would be done in cooperation with FAO and MMR. A biostatistician from FAO would be working on the project for a short time (FAO 1993b).

6.2.5 The Global Environment Facility (GEF) Eritrean coastal conservation project proposal

This important project proposal which is in the final stages of review for funding authorization ($6.8 million US) is to conduct a comprehensive coastal and conservation resource assessment of the coral reef areas of Eritrea's coastal waters. This project proposes to: (1) conduct an ecological inventory of nearshore coral reef

and associated communities; (2) select areas for protection and management that have the maximum levels of biodiversity and endemism, and also serve as habitat to support fish stocks; (3) develop habitat maps and a marine resource data base for management and research purposes; (4) conduct environmental monitoring programs to assess the impacts of human activities and natural variations on these coral reef and coastal ecosystems; (5) provide some scientific and technical training in research, monitoring, and management; (6) involve the local community in project activities; and (7) establish linkages with other similar projects in the region (UNDP 1993b).

6.2.6 The Eritrean diver training program

Begun and independently financed by a private individual, a number of Eritrean Navy divers were trained and certified by an Italian dive instructor. The instructor also donated many sets of scuba equipment for their use. At present these trained navy divers operate the Dahlak Island guest facilities and offer organized scuba diving support to visiting tourists and officials. At present these same divers are also currently building new guest facilities on the island for use by visitors.

6.2.7 Aldo Jacober Architects

This Italian architect is volunteering his time, along with a team of thirty architects, designers, and planners, to assist the government of Eritrea to address issues regarding urban planning, building codes, and regional development plans. A main focus of these efforts is assisting the Department of Tourism on the design of a master plan for tourism development, including recommendations regarding coastal tourism and a marine park, or multiple use marine resources management area, in the Dahlak Islands Archipelago region.

6.2.8 The Manzanar project continuation

This is an ambitious project to pond culture mullet and milkfish in intertidal impoundments. The design is an integrated system of cultivated mangroves, aquaculture ponds, and agriculture using the nutrient-rich pond waters. The original volunteer project (Manzanar Project) attempted to raise fish in ponds located near Hargigo, but met with little success. This project is presently in the stages of being redesigned (Sato 1993).

6.2.9 Zula Fisheries Community Development Program

The Zula project is supported by OXFAM-Canada with 600,000 $CND. It is a three year socio-economic fisheries development project which targets the village communities surrounding the Bay of Zula, south of Massawa. The main objectives of the project are to promote community self-sufficiency by rehabilitating the community structural systems, improving the ability to harvest marine resources both

for food and income, and increasing the role of women in artisanal fishing activities. Training in fisheries harvesting and marketing are important components of the project which will require technical assistance in the form of a long-term master fisherman for two years, and short-term technical trainers for refrigeration and engine maintenance (OXFAM-Canada 1993).

6.2.10 Proposal to Programme for Refugee Reintegration and Rehabilitation of Resettlement Areas in Eritrea (PROFERI) for the development of prototypical fishing communities on the Red Sea coast, Sahel province, Eritrea

This proposal was developed by the MMR to address the problem of resettling returning refugees. It has been submitted to PROFERI, but has not received funding as of yet. The main activities of the project are to (1) construct two coastal communities for 500 people each, including housing and infrastructure, to be located at Mersa Ibrahim and Hasmet along the Sahel coast. Each village would house about 100 families to be selected among the refugees returning from Sudan. (2) Among these 1000 people, the project would train about 50 in mechanical trades, fish processing, management and commerce, about 200 fishermen would receive "reorientation training" if necessary, and 40 women would be trained in net making and repair. (3) The program would create the fisheries infrastructure by providing boats, landing and marketing facilities, gear, drying equipment, transportation, cold storage facilities, and ice makers. (4) Environmental education would also be provided. (5) A management plan for sustainable fisheries development in the area would be developed. (6) The formation of local fishing cooperatives would be supported. (7) Basic nutritional, dietary and home economics education would also be provided (MMR 1993d).

6.2.11 The University of Tel Aviv research expedition

The university will conduct a two week research expedition in and around Eritrean waters for pure scientific purposes. The research is focusing on three areas - gathering drilled core samples from coral heads for laboratory analysis to detect changes in sea temperature, chemical composition, and other parameters. This will be used in global climate change research. The second project is to collect sponges and tunicates for laboratory analysis as possible sources of genetic material for pharmaceuticals treating immune system disorders. Third, the expedition is to collect various specimens to supplement the collections of Tel Aviv University and Asmara University (Hillman 1993e).

6.2.12 The VITOS Ltd. fisheries joint venture resource assessment

The project, which has been authorized, is a proposed joint fishing venture with the MMR which is also intended to provide fishery resource assessment information. An

analysis of the proposed joint venture research activities, indicates that neither has a scientific program been detailed nor has the survey capability of the company been justified. Even though the stated main objective is to gather, record and analyze scientific data on the availability of fish in Eritrean waters, and train Eritreans in fishing and scientific research, it is also clear that the joint venture may fish to "supplement the expenses of the scientific research." No definition of "supplement" nor any limit on the allowable catch is specified. There are many uncertainties regarding what kind of research will be conducted, and how, what scientists will be involved, and the extent of fishing that will be carried out. The proposal does adequately outline the financial cost-sharing responsibilities of both parties, however it does not identify projected normal operating costs of the identified fishing vessel (MMR 1993e).

6.2.13 Proposals to assist in urban planning for coastal areas

There are several proposals to assist Eritrea in urban planning for coastal areas. One of these is a United Nations Economic Commission for Africa proposal to work on a national development planning project, multi-sectoral development framework, and regional development plans, including the coastal area. Another is the United Nations Economic and Financial Management Program (with UNDP providing the overall projet support) which is considering involvement in assisting the development of the master plans for the reconstruction and development of Massawa and Asmara. Housing development is included as a key element. Various towns in different regions are being targeted. Lastly, USAID is said to be investigating the possibility of offering planning support to assist in the design of the master urban development plans for Assab and Massawa. While little information is currently available on these proposed activities, it is clear that several different agencies are considering granting assistance in the urban planning area.

6.3 A brief review of the gaps in international donor assistance to the sector

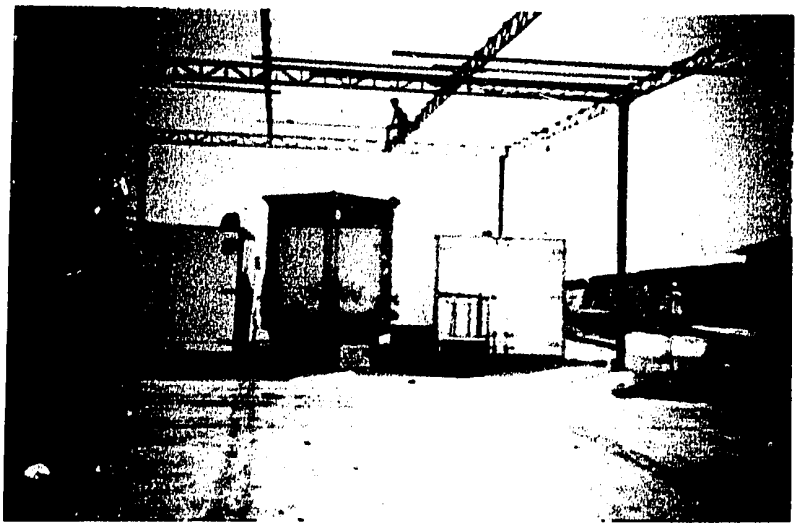
Although the described donor programs are both necessary and commendable, they by no means completely address the total needs of the Eritrean marine resources. Although the artisanal fish harvest and marketing sectors are receiving adequate attention, the most obvious gaps in technical assistance are in the areas of fishery resource stock assessment and coastal zone management inputs.

Specifically what is still needed is the means to gather, store and analyze data on fish stocks, catch, and effort. This is needed to manage the fisheries development on a sustainable basis. The other gaps that are left by these assistance programs are (1) the means to gather, store, and analyze information on marine resources and habitats, and (2) the guidelines and plans for managing use of coastal and marine resources so as to protect the environmental quality of these habitats necessary for sustaining fisheries productivity, as well as other economic uses of these resources.

It is admirable that the Eritrean proposals and plans specifically identify the concept of sustainability in renewable resource management and the importance of conserving their coastline. This is especially notable since the entire financial, economic, and production infrastructure of Eritrea was destroyed during the devastating war period. An entire generation of Eritreans have grown up knowing nothing more than war, famine, and natural devastation. Knowing such natural devastation may be the reason that the concept of wise environmental stewardship is so strong in every Eritrean, young or old, from government official to coastal fisher alike. Such stewardship and environmental caring are concepts which developed nations have only recently begun to remember.

In light of this strong environmental ethic, the government decision makers have openly stated two needs: that they lack the necessary data and information upon which to base sound management decisions; and they lack experienced personnel to interpret and apply the information which will be acquired. The key to their need is the lack of experienced personnel because Eritrea does possess educated and competent leadership. The immediate task of Eritrea is to rebuild itself up from the ground rubble, both economically and structurally. The Marine resources, which have received a reprieve from a generation of serious human impact, have been identified as an important part of this rebuilding process as sources of employment, nutrition, and economic trade. Yet, the Eritreans realize that their fishery and other coastal resources are vast but fragile. They recognize that poorly planned coastal redevelopment can have catastrophic results. It is for these reasons that experienced technical assistance in the areas of resource assessment and coastal planning have been identified as the most immediate need.

Minister of Marine Resources
Saleh Meky



Only cold storage for fish landed in Massawa.

7.0 RECOMMENDED COASTAL AND MARINE RESOURCES MANAGEMENT PROJECT

A review of the available reports, study of existing and pending international donor projects, discussions with numerous international donor and Eritrean government and industry representatives, and field trips to some key fishery and other coastal resource development areas, have revealed the necessity of international donor assistance if Eritrea is to exploit its coastal and marine resources expeditiously, yet in a manner which will maximize the long-term sustainable net benefits. Accordingly, a preliminary design of an international donor assisted coastal and marine resources project is presented below.

The recommended project is based on a thorough review of the constraints and opportunities faced by the development of Eritrea's coastal and marine resources. It is carefully crafted to focus on the key policy initiatives of the Eritrean Ministry of Marine Resources (MMR), and it is designed not to duplicate but to complement, extend, and build on other international donor assisted projects in fisheries and other related coastal resource areas. This project synergistically complements UNDP's GEF Project and the UNDP/FAO Semhar-Assab Project. Finally, the recommended project is not only consistent with the coastal and marine resources sustainable development strategy recommended above, but it is also a necessary component if that strategy is to be successfully implemented.

7.1 Project profile

This section provides a profile of the recommended Eritrea Coastal and Marine Resources Project. Following an overview of the project is a concise description of the project. This is followed by a brief review of the needs and objectives; a review of the specific benefits, outcomes, and products of the recommended project; a discussion of the preliminary assumptions; and, finally, a summary of preliminary financial information. This section, then, provides the reader with an overview of all of the aspects of the project. The following sections will explore the dimensions of the project in much greater detail.

7.1.1 Overview of the recommended project

The key organizing concept around which the project is designed is that of information for resource management. Coastal and marine resources management must be based on appropriate, accurate, and timely information on which resource management policy, prescription, and enforcement can be based. The management of any development process requires reliable information. However, sustainable development requires policy-relevant information that reveals linkages to related sectors and resources as the development process unfolds. In addition, the feedback mechanism

between resource use and the ability to detect negative environmental impact must be rapid and accurate. Sustainable resources management is not a static process, wherein good policy is put into place and appropriate development follows. On the contrary, sustainable development of natural resources requires an on-going dynamic process of information collection and analysis that is integrated with a continuing process of policy review, evaluation, and adaptation. The project activities recommended here are focused on providing assistance to the MMR, and other related agencies, to develop an appropriate information management system and a comprehensive coastal and marine resource management framework for promoting the sustainable development and management of Eritrea's coastal and marine resources sector.

Within the framework of providing information for an integrated and coordinated management of marine and coastal resources development, the cornerstone of the project is the establishment of an on-going fishery stock assessment capability that is based on the output of a sound information management system. Even though the sustainable development and management of the fishery sector is the central component of the project, the fishery sector is not the sole focus of the project. Ensuring the sustainable development of the fishery sector requires that related coastal resources development, such as tourism, urban, and industrial uses, be integrated into an overall sector-wide strategy. Furthermore, the development of a regional multiple use marine resources management framework, particularly in the Dahlak Islands Archipelago, provides a key link between the sustainability of the fishery and ecologically sound tourist and other developments in the region.

7.1.2 Concise description of the recommended project

The recommended project would provide the necessary technical assistance and training to establish and maintain a coastal and marine resources management system which would promote the continued sustainable development of these resources. The key features of the recommended project are 1) the establishment of a fishery stock assessment and management system for Eritrea's Red Sea fishery, 2) the establishment of an integrated coastal resources planning system for the Dahlak Islands Archipelago and nearby mainland coastline to promote environmentally appropriate urban, industrial, and tourist development, and 3) the establishment of a regional multiple use marine resources management planning framework for the Dahlak region to promote sound fishery development and compatible use of the marine and coastal resources.

7.1.3 Needs and objectives

Devastated by thirty years of war, the Eritrean economy and infrastructure has been destroyed or degraded. The marine sector, like virtually every other sector of the

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economy, must be reconstructed and rehabilitated. This revival takes place in one of the poorest countries in the world. Eritrea needs significant outside assistance in rebuilding its economy. Many of Eritrea's skilled people fled the war torn country, and many more were denied the training and education required in a modern economy. With the private sector devastated by the previous regime, the Government has taken responsibility for rebuilding the economy and infrastructure. The fisheries sector is no exception. A rapid reconstruction of the fisheries sector will require substantial levels of outside assistance and training. A most critical need is that for skilled planners and resource management personnel.

Numerous international donor assisted projects already address the need to rebuild the infrastructure of the fishery sector. Perhaps the most critical unaddressed need is the required assistance in establishing a stock assessment and management system in order to promote the sustainable development of Eritrea's Red Sea fishery resources. There is a great need for an information system which can guide policy makers, planners, and fishery management personnel in prudent management to promote the sustainable development of the fishery resources. One of the key objectives of the recommended project is to provide the necessary technical assistance and training required to establish and maintain such a fishery stock assessment and management system.

The MMR has appropriately put the redevelopment of the small scale artisanal fishery as its top priority, in order to promote both domestic employment and fish consumption. However, Eritrea cannot alone fully exploit its fishery resources, nor can it consume all of its sustainable fish yields. This excess fishery capacity, combined with the desperate needs for foreign exchange, creates opportunities for joint ventures or licensing of foreign fishing vessels to assist in exploiting and consuming Eritrea's abundant fish stocks. Unfortunately, Eritrea has little information on the actual status of its fishery resources. A thorough assessment needs to be made of the available stocks and sustainable yields. A fishery management system needs to be established to assess and manage the appropriate scale and methods of exploitation of each particular resource. In addition, the fishery resources need to be regulated and monitored if the rapid reconstruction of Eritrea's fishery resources is not to lead to rapid depletion and a loss of the potentially sustainable productivity of the Red Sea fishery. Eritrea urgently needs to establish a national fishery information system which can guide policy decisions and sustainable management of the fishery.

Limited trawling for some deeper water demersal species might be appropriate. Many foreign companies have expressed keen interest in trawling in Eritrean waters under joint ventures or lease-rights agreements. However, uncontrolled trawling could rapidly deplete its modest fishery resources or do long-term environmental damage to coral reefs and other bottom environments. Properly managed, Eritrea's Red Sea fishery can make a substantial contribution to the country's food supply, gainful

employment, economic development, and foreign exchange earnings. But, to properly manage the exploitation of these natural resources, Eritrea requires international donor assistance in developing a fishery stock assessment and management system as soon as possible.

In addition to technical assistance in establishing a stock assessment and management system, Eritrea also needs a substantial amount of training for Eritrean staff in data collection, processing, and analysis to maintain that assessment and management system. Short training courses for enumerators and data entry and analysis personnel are needed in order that Eritrea will have the trained staff required to provide sustainable management of its fishery resources. Eritrea also needs technical assistance and training in developing the capability to monitor and control the fishery, and preventing illegal, destructive, or unapproved fishing activities. The objective of the recommended project would be to provide the required technical assistance and training to establish and maintain an efficient and effective fish stock assessment and management system.

Eritrea also needs to develop an integrated coastal resource management plan for the Dahlak Islands Archipelago, a major center of the artisanal fishery and one of the most likely sites of tourism development. The Dahlak area is an extensive, well preserved coral reef area which has a variety of marine life habitats and is the site of some of Eritrea's unique historical and archeological assets. There is increasing pressure to develop tourism facilities and rehabilitate the military/industrial facilities on Dahlak Kebir and other islands. Population will continue to grow as well. Use of reef areas for fishing and recreation will increase. All of these activities can potentially cause significant impact on the fragile Dahlak Islands Archipelago environments through waste disposal, pollution, erosion, deforestation and other means. An integrated coastal resources management plan and development guidelines are needed to protect these environments and sustain the coastal resource use in the area.

The Dahlak Islands are also near the Massawa area where reconstruction and development of the urban, industrial, and port activities can cause impacts to the adjacent coastal water area and potentially to the islands themselves. So, a second critical element in the recommended coastal resources component is to assist the MMR and related agencies in developing and implementing an integrated coastal resources management plan for the mainland coastal region around Massawa. This part of the recommended project would complement the Eritrean government plans for rebuilding Massawa's urban, industrial, and port facilities, and would link with other proposed or pending international donor assistance targeted to help develop a Master Plan for Massawa development, the redevelopment of the port facilities, and the development of a Master Plan for Tourism Development. In fact, in view of these development plans, it is imperative that an integrated coastal resources management plan be developed and implemented. Technical assistance and training is required to

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assist Eritrea in promoting environmentally sound agricultural, urban, and industrial developments, while protecting the valuable artisanal fishing resources and preserving the coral reef and other natural marine life habitats in the Dahlak Island areas and mainland coastal areas for achieving optimal development of Eritrea's tourism industry.

The recommended project would assist in developing guidelines for ensuring environmentally sensitive coastal land use and in incorporating these guidelines into the tourism development plan, urban reconstruction plans, and regional development plans for the area. These guidelines and a process for reviewing development proposals to evaluate their compatibility with the integrated coastal resources management plan, applicable on the mainland coastline as well as on the islands, would be a focus of the project. Long and short term technical assistance is recommended to assist the Government of Eritrea in these planning efforts. Similarly, short term training programs would accompany the long term technical assistance to assure the development of Eritrea's capacity to continue the further development of its integrated coastal resource management plan. The integrated coastal resources planning efforts would be directed to the Dahlak area first, then to the development of the Massawa area, and finally extended to address coastal resources management planning along Eritrea's 1,155 km coastline.

Finally, as a complement to the coastal management plan for the Dahlaks, the MMR needs to establish a multiple use management scheme for the marine areas in the Dahlak region. The creation of a regional multiple use marine resources management area is required to ensure that the entire ecosystem is properly managed. It must be emphasized that a wide variety of uses, both consumptive and nonconsumptive, are allowed and managed within such a marine resources management area to ensure the sustainability of the whole ecosystem. Marine resource management areas are an important coastal management tool to promote sound fishery development and environmentally appropriate urban, industrial, and tourist development. These multiple use marine resource management areas are an essential element both in the sustainable management of the Red Sea fishery and in ensuring the balanced, environmentally sound management of coastal resources as a whole. Development of a marine resources planning system for the Dahlak region is consistent with the MMR's strong emphasis put on marine ecosystem protection and environmentally sustainable development. National and international conservation experts have, for over twenty years, promoted the establishment of a marine resources management system, including marine parks or conservation areas, in the Dahlak Islands (Blower 1970). The proposed, UNDP/Global Environment Facility (GEF) project which the RDA team strongly recommends for funding, is the first step necessary for a comprehensive marine resources management planning system for the Dahlak Islands. The recommended project would complement the GEF survey with the development of a zonation and management system for regional marine resources, helping to

identify reserve areas for protection, as well as multiple use areas for fishing or resource exploitation of other kinds.

While there is a need to establish protected areas for fish replenishment in the south of the country's waters as well, the most critical area in need of non-fishing reserves is the Dahlak Islands Archipelago, including the many shoals, coral reefs, sea grass beds and other formations extending to the edge of the Dahlak Bank in the north at Saunders Reef. It is in this area that there is the greatest concentration of fishing pressure, and potential future conflicts with tourism development and oil and gas development.

There is an urgent need to establish these non-fishing reserve area for fish replenishment early in the development of Eritrea's fishery in order to gain the support of fishers whose current catch rates are unsustainably high due to the under-exploitation of the stocks during the war. The fishing community will be more likely to support the creation of non-fishing reserves and fish replenishment zones in the marine resources management area while catch rates are high, rather than later when catch rates have fallen to more sustainable levels.

After establishing these non-fishing reserves, the next step is to set these in the context of a multiple use management scheme. By doing this, the recommended project would address the problem of teaching the fishing community about the importance of the conservation areas to improving the sustainable productivity of the whole fishery. One area is protected so that the villagers can keep fishing in other areas for generations to come. These protected areas could also be rotated, too. The project would also enlist the fishing communities' support in enforcement and reporting of illegal fishing activities in those restricted areas. Preservation of such non-fishing reserves protects the sustainability of the fishery by ensuring continued sources of recruitment to the steadily fished areas and provides fishery managers with continuing information on the unexploited condition of the fishery against which to measure the impact of fishing effort on the fish stocks in the bulk of the fishery. The recommended project would build on the cooperative, community based resource management approach recommended by the GEF project, strengthening the sense of stewardship of the resource by the local community. In addition, the establishment of a marine resources management system would strengthen the efforts to develop tourism in Eritrea's Red Sea environment, maintaining some pristine, natural areas for eco-tourists, divers, and others wanting to share in Eritrea's natural marine beauty.

The recommended project would supply technical assistance in identifying appropriate locations and boundaries for the regional marine resources management area in Eritrea's Dahlak Islands Archipelago, as well as the appropriate delineation of multiple use management zones and reserve areas within the management area, their sizes, regulations, and management schemes. It would also install pin-mooring buoys to

minimize the damage done by anchors on the coral reefs. In addition, the project would provide training programs for marine resources management area planners, managers and rangers; for those responsible for installing and maintaining mooring buoys; for fishermen, divers, and tourism industry personnel in environmental sensitivity and environmental interpretation techniques for visitors using scientific and traditional perspectives; and for relevant navy and defense department personnel in how they can assist in the monitoring and surveillance of the marine parks. Workshops with the local communities would be carried out to ensure their participation in developing appropriate management regimes for the marine resources management area, and identifying potential economic development opportunities utilizing the marine resources within the management area.

Technical assistance and training in the three components of the project--the establishment and maintenance of a fishery stock assessment and management system, of an integrated coastal resources management system, and a regional multiple use marine resources management plan for the Dahlak Islands Archipelago--together meet the critical coastal and marine resource needs confronting Eritrea as it rebuilds and develops it fishery and coastal communities after three decades of war.

7.1.4 Specific benefits, outcomes, and products of the recommended project

The principal outcomes of the recommended project include the following:

1. Eritrea will have in place a fishery stock assessment and management plan which can guide the sustainable development of its artisanal and other fisheries so as to achieve the optimal fish harvest levels, maximizing over the long run its domestic fish consumption and earning substantial amounts of foreign exchange from fish exports.

2. The MMR will have the technical capacity to continue implementation of its fishery stock assessment and national fishery information system, and to analyze and interpret that information to guide policy decisions and rational sustainable fishery resource management.

3. For the fragile Dahlak Islands Archipelago, the MMR will have a fishery and marine resource monitoring, surveillance, and control system, and the trained personnel required to manage such a system, to ensure that illegal, destructive, or unsustainable fishing or other marine practices or activities are restricted to a minimum.

4. Eritrea will have a fully developed integrated coastal resources management plan for the Dahlak Islands Archipelago to guide optimal resource use and balance the conflicting interests of fishery, tourism, industrial, urban, and agricultural developments that have an impact on the environmentally sustainable development of the region.

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5. Eritrea will have coastal resources management measures prepared for incorporation in the redevelopment efforts for the coastal towns of Massawa and the surrounding region, and in the general guidelines and review process for integrated coastal zone management of the entire Eritrean coastal area.

6. Eritrea will have an established regional multiple use marine resources management plan for the Dahlak Island area. This will ensure the sustainability of the artisanal fishery, assist in the proper management of the fishery resources, protect environmentally sensitive areas, provide for the optimal tourism development on the islands, and ensure compatible multiple use of the marine resources of the region.

7.1.5 Preliminary assumptions

The success of the project is based on numerous preliminary assumptions, which are outlined below.

First, it is assumed that the several coastal and marine resources related projects reviewed above in section 6.0 are successfully implemented. These projects include the UNDP and UNCDF Semhar and Assab Fishery Development Projects, along with the numerous related Italian, Japanese, and smaller NGO fishery development projects. It is also assumed that the GEF biodiversity project is funded and implemented in order that a baseline inventory of the coastal and marine habitats is developed. Further, it is also assumed that international donor assistance to the development of a master plan for urban reconstruction and development, particularly in Massawa, is forthcoming. In other words, it is assumed that Eritrea's domestic resources and those from approved or pending (but almost surely funded) international donor assisted fishery and coastal resource development projects are successful in rebuilding the marine fishery and related port, landing facilities, fish storage and distribution systems, along with reconstructing the city of Massawa, promoting the development of industrial activities in Assab and Massawa, and the tourism industry in the Massawa area. The recommended project complements these economic development activities by creating the capacity to successfully manage the sustainable development of the coastal and marine resources.

Second, it is assumed that the Eritrean policy of promoting and encouraging the development of the private sector and the expansion of free markets remains in place. While it is understood that the Eritrean government has taken direct control over many production and marketing facilities as necessary, and taken steps to reestablish production and distributions systems which were destroyed or debilitated during the war, the success of the recommended project depends on the gradual transfer of much, if not all, of the ownership and control over fishery and marine product and services production and distribution networks to the private market.

7.1.6 Overview of financial information

International donor assistance in US$ required to implement the recommended project over three years is estimated at approximately US$3,300,000. The required Government of Eritrea contribution to the project is estimated at approximately US$600,000.

7.2 The problem

The Eritrean economy has been decimated by the thirty year war for liberation. Its infrastructure was systematically destroyed or dismantled during this war. Its industry, agriculture, and marine production sectors, its transportation, communications, energy, and water systems, and virtually every sector of its economy must necessarily be built up from nothing or from a small proportion of what once existed. The new government of Eritrea is being created in the midst of a war-torn economy. Furthermore, this reconstruction and rehabilitation of the Eritrean economy is taking place in the context of one of the poorest economies in the world. Unlike the reconstruction of war-torn Europe following WWII, where the human capital was readily available to assist the reconstruction process, Eritrea is faced with rebuilding an economy which was desperately poor to begin with. Eritrea needs the equivalent of a Marshall Plan to jump start its economy.

While Eritrea is fortunate to have many skilled people, particularly among the returning refugees and repatriated citizens which fled to other countries during the devastating war, it is still in need of much technical assistance and training in organizing and managing its resources. A generation of Eritreans missed out on the acquisition of the array of technical skills which will be required to reconstruct and develop a modern economy. Much technical assistance and training will be required in almost every sector of the economy to facilitate and sustain the continued economic development of Eritrea. There is a serious shortage of skilled human capital in the government sector which has had to step in and get the basic production and distribution systems functioning again. At the same time, the private sector, too, has been deprived of much of its educated, trained, and skilled manpower resources. As an example, one only has to look at Massawa, Eritrea's major northern port city which is the supply terminal for foreign goods to the city of Asmara and Eritrea's and Ethiopia's northern areas. Massawa today has only about a quarter of the population it had in the 1960s, and its housing, industrial facilities, roads, and nearly its entire infrastructure has been destroyed or debilitated by the war. Similarly, Eritrea's Red Sea fishery, a substantial part of which is in the Dahlak Islands Archipelago some 50 km offshore from Massawa, is currently operating at a small fraction of its earlier levels. Rebuilding Eritrea's fishery and other sectors will require significant amounts of international donor assistance in the form of technical assistance and training, in addition to a

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dedicated effort by Eritreans. Nowhere is the immediate need more critical than in the area of skilled planners, developers, and resource management personnel.

7.2.1 The need for a stock assessment and management system for the Red Sea fishery

In the coastal and marine resources sector, Eritrea and the MMR need to establish a stock assessment and management system in order to facilitate the sustainable development of its fishery. While numerous projects are directed toward rebuilding the fishery infrastructure, equally, there is an urgent need to put in place an information system which can provide necessary decision making facts and figures to policy makers and planners. This data can facilitate a reliable fishery stock assessment and a prudent management system that can promote the sustainable development of the fishery resources. One of the key problems facing the MMR is the need for the technical assistance and training required to establish and maintain such a fishery stock assessment and management system. Only with such a system will the Eritrean government have the necessary information on its fishery stocks to wisely determine the manner and intensities of fishing effort which are appropriate for guiding the sustainable development of its fishery resources. As the capacity to make such decisions is being built, management of Eritrea's fisheries resources should proceed, with caution, on the best available information.

Appropriately, by not opening the Eritrean continental shelf to foreign flagged trawlers, the MMR has emphasized Eritrea's goal towards reconstruction and further development of its artisanal fishery on a sustainable basis. This approach will promote the expansion of both domestic employment and fish consumption as a means of achieving food sufficiency. At the same time, there is the national economic need to promote the full exploitation of its fishery resources, not all of which can be exploited by the domestic artisanal fleet or consumed by the local population. While it is quite appropriate to promote the development of the artisanal fishery from its current debilitated status, even in advance of a careful assessment of stocks or monitoring of the catch, any significant exploitation of Eritrea's other fish stocks should cautiously await the establishment of a stock assessment and management system. The available stocks and sustainable yields need to be assessed and the scale and methods of exploitation of each particular resource need to be regulated and monitored. One can think of the coastal resources, including fisheries, as a natural stock of capital that yields a stream of benefits that could benefit Eritrean society in perpetuity so long as this capital is kept in good condition. Early, unregulated exploitation could lead to serious stock depletion or to long-term damage to coral reef or other sensitive areas. Hence, it is imperative that Eritrea soon begin to put into place a national fishery information system which can guide policy decisions and sustainable management of the fishery.

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Some of its deeper water demersal species might best be exploited by controlled trawling, currently feasible only by foreign vessels under joint ventures or lease-rights agreements. However, Eritrea's trawl fishery was never very large, and today's trawling technology has advanced to the point that uncontrolled trawling effort could rapidly deplete its modest resources or do long-term damage to its reef areas. Thus, it is important that Eritrea receive assistance in developing a fishery stock assessment and management system as soon as possible so that it has the necessary information with which to grant such rights and manage such exploitation without damaging consequences to the future sustainability of its fishery resources.

Earlier estimates of Eritrea's maximum sustainable yields (see Table 3-3 above) give the appearance that Eritrea's fishing resources are much larger than they are in fact. In these estimates the sardine fishery accounts for upwards of 60 percent of Eritrea's sustainable yield by tonnage, yet these sardines are a low valued product and it is difficult to assess the best use of these resources. While, on the one hand, these sardines may prove valuable as a domestic product, either canned or dried, or as input to the production of silage. On the other hand, it may be that these resources are most valuable to the fishery in their unexploited state as an important link in the marine ecosystem food chain sustaining other larger species. In any case, Eritrea's high valued food fish resources are relatively modest (20,000 mt/year). If earmarked for the local artisanal fishery, this yield can supply employment and food for Eritrean products, and for some high valued export products to targeted regional markets. Managed properly, Eritrea's high valued fishery resources can make a substantial contribution to its economic development, gainful employment, and food supply.

A necessary complement to the need for establishing a comprehensive fishery stock assessment and management system is the need for an Eritrean staff trained in data collection, processing, and analysis in order that the system can be maintained. Enumerators and data entry and analysis personnel all require training courses. The development of the national fishery information management system required to manage a fishery in a sustainable manner requires a well trained staff. The staffs of the MMR and other relevant Eritrean agencies, such as the navy, require assistance and training to develop an adequate capability in fishery Control, Monitoring and Surveillance to prevent illegal, destructive, or unapproved fishing practices or activities.

7.2.2 The need to develop an integrated coastal resource management plan for the Dahlak Islands Archipelago and the Massawa coastal area

Eritrea needs to develop an integrated coastal resource management plan for the Dahlak Islands Archipelago. The Dahlak area is a major center of the artisanal fishery. It is also an area with significant biodiversity and conservation value. It is viewed as a prime area for tourism development areas because it contains some of the most

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extensive and relatively well preserved coral reef areas, a variety of habitats for some of its most outstanding marine life, and some of Eritrea's unique historical and archeological sites. Dahlak Kebir is the location of a naval base that has a significant number of industrial facilities already built, though damaged from the war. Managing the environmental impacts of the reconstruction and rehabilitation of these facilities and other uses of these islands is a clear and obvious need.

Dahlak Islands are offshore from the central Eritrean coastline where new settlements and agricultural developments are anticipated, and from the Massawa area where urban, industrial, and major port developments will see major reconstruction and development during the next few years. So, the fragile Dahlak Islands Archipelago environments will face increasing challenges from agricultural, urban, industrial development, and shipping waste, and other impacts.

The Eritrean government has already emphasized the necessity of rebuilding and expanding Massawa's urban, industrial, and port facilities. Proposed or pending international donor assistance is already targeted to helping develop a Master Plan for Massawa development and for the reconstruction and development of the port facilities. Similarly, there are plans to develop a Master Plan for Tourism Development. In the context of these development prospects, it is of utmost importance that an integrated coastal resource management plan be developed and implemented. Such a plan, and the development of the capacity to continue implementation, monitoring, and revision of that plan, would play a key role in promoting environmentally sound agricultural, urban, and industrial developments, while protecting the valuable artisanal fishing resources and preserving the coral reef and other natural marine life habitats in the Dahlak region and mainland coastal areas for achieving optimal development of Eritrea's tourism industry.

Guidelines for ensuring environmentally sensitive coastal land use need to be developed and incorporated into the tourism development plan, urban reconstruction plans, and regional development plans for the area. A process for reviewing development proposals to evaluate their compatibility with the integrated coastal resources management plan also needs to be developed. This process should be applicable on the mainland coastline as well as on the islands.

The development of an integrated coastal resources management plan and the capacity to manage future coastal economic expansion would be a companion piece to the needed fishery stock assessment and management system discussed above. Eritrea does not have the trained specialists required for this planning effort. Eritrea needs to develop its planning capacity to develop an initial integrated coastal resources management plan and to continue this planning effort. Technical assistance and training will be required to overcome Eritrea's shortage of skilled coastal resource planners. While developing a coastal resources management plan in the Dahlak

Islands Archipelago is the most urgent need, Eritrea also needs to see to it that coastal resources planning concerns are integrated into its developing tourism master plan and other donor assisted projects in urban reconstruction and development of Massawa when these projects get underway. Once Eritrea has developed an integrated coastal resources management plan for the Dahlak and Massawa areas, it then needs to build on this experience to address the coastal resources management planning along its almost 1,200 km coastline.

7.2.3 The need to establish a regional multiple-use marine resources management plan for the Dahlak region

The MMR needs to establish a regional, multiple-use marine resources management planning system in the Dahlak Islands region as an important management tool for the promotion of sound fishery development, protection of its marine biodiversity, and the management of environmentally appropriate, industrial and tourism development of the marine area. This regional marine resources management area is an essential element in both the sustainable fisheries management and in ensuring the balanced, environmentally sound management of all the coastal and marine resources.

Development of the regional marine resources management area emphasizes the management of multiple uses in the marine area to ensure the environmental sustainability of all these uses. It is consistent with the clear policy objectives supporting marine ecosystem protection and environmentally sustainable development that are espoused by MMR and other Eritrean officials. Marine resources management areas with multiple use management schemes have been shown to be an effective tool for addressing in part the three major concerns discussed above in Chapter 5. These concerns are: (1) maintaining the biological productivity of the marine resources, (2) balancing development and conservation of marine resources, and (3) protecting those marine resources that are not of direct monetary value.

The establishment of a regional marine resources management area in the Dahlak Islands has been promoted by national and international conservation experts for over twenty years (Blower 1970). The Eritrean government has the political will and supporting policy objectives to bring this proposal to reality. The UNDP/Global Environment Facility (GEF) project is the first step necessary for a comprehensive marine resources management plan for the Dahlak Islands Archipelago, and other marine and coastal areas of Eritrea. However, there is a need to go beyond the initial biodiversity and habitat inventory survey projected by the GEF project. There is also a need to complement the GEF survey with the identification of the key fishery replenishment areas, along with the areas for the other various and multiple uses of the marine region. With this information, the MMR needs to develop a zonation and management system for the regional marine resources management area. Within the overall management area, Many marine resources zones could be established even as

the survey work is being conducted. Zonation must be flexible, adapt to new information, involve the local community and users, and be in place as resource development occurs. The project recognizes that there is a need to establish fish replenishment areas in the southern islands as well as other areas besides the Dahlak Islands Archipelago. However, the most critical need is to manage the Dahlak Islands Archipelago first, since it has the largest and most significant fishery and other marine resources, as well as the potential for the greatest conflict with growing pressures in the future.

It is important that non-fishing reserves and fish replenishment zones of the marine resources management area be established early in the redevelopment of Eritrea's fishery. Catch rates are unsustainably high at the present, since the fishery has not been fully exploited for many years due to the disruption of the fishing industry during the thirty years of war. Fishers will be more agreeable to accept areas of no fishing while catch rates are generally high than at a later time when catch rates have fallen, and costs have risen, to a more realistic and sustainable level. The fishing community can be taught about the importance of the conservation areas in improving the sustainable productivity of the whole fishery. They can also, most likely, be enlisted to lend support in the enforcement process by monitoring and reporting illegal fishing activities in those restricted areas.

Preservation of such conservation areas protects the sustainability of the fishery by ensuring continued sources of recruitment to the steadily fished areas. Further, these non-fishing reserves and fish replenishment zones of the marine resources management area are also an essential aspect of managing the fishery, for they allow the managers to learn about the system being managed by providing the three elements of experimental design that are necessary to understand the harvest related impacts on the fishery, namely, control, contrast and replication. These marine reserves are control areas providing continuing information on the unexploited condition of the fishery against which the fishery management specialists can gauge the impact of fishing effort on the fish stocks in the bulk of the fishery. The system of cooperative, community based management of resources recommended by the GEF project is lauded and needs to be emphasized. The instrument used is an incentive structure that fosters stewardship of the resource by the local community.

Establishment of these non-fishing marine reserves, additional fish management areas, and other zones for management of extractive and nonconsumptive uses are all aspects of the regional marine resources management system. In this way, development of a regional marine resources management system is also consistent with the efforts to develop the multiple uses of Eritrea's marine resources. In particular, the successful development of tourism in Eritrea's Red Sea environment requires that some pristine, natural areas be preserved for eco-tourists, diving tours, and others seeking to share in Eritrea's natural marine beauty.

However, Eritrea lacks the trained personnel who could identify the appropriate locations and boundaries for the fish replenishment areas and multiple use zones in the marine resources management system for Eritrea's Dahlak Islands Archipelago, in addition to developing the regulations and management schemes for each zone. Eritrea requires assistance in establishing the marine resources management system and in training local personnel as marine resources management area planners, managers and rangers. The MMR would need assistance and training in the installation and maintenance of pin-mooring buoys. Training is needed to raise the environmental awareness of local fishermen, divers, and tourism industry personnel so they can better interpret that environment for visitors. So too, technical assistance is needed to gather local traditional knowledge of the area and its resources. Navy and defense department personnel need training also in how they can assist in the monitoring and surveillance of the marine resources management areas. The participation of local communities is essential in developing appropriate marine resources management regimes. The MMR and technical assistance experts are also needed to work with the island villagers to identify potential economic development opportunities utilizing the marine resources within the regional management system. To conduct these activities, Eritrean staff needs assistance and training.

7.3 Project objective

The objective of the project is to provide Eritrea with the necessary technical assistance, training, and infrastructure to assist in establishing a fishery stock assessment and management planning system in association with a coastal resources management system and an appropriate regional multiple use marine resources management system. The target audience for this effort is the MMR and the institutions and communities associated with and dependent on the development of Eritrea's coastal and marine resources. These fisheries and coastal management systems are necessary so that Eritrea's coastal and marine resources can be managed in such an environmentally sound manner as to assure the maximum sustainable economic and social benefits from these resources for the current as well as future generations. This is to be done while balancing the requirements of creating employment, generating income, increasing domestic fish consumption, and earning foreign exchange.

In sum, there are three principal objectives of the recommended project:

1. The establishment of a fishery stock assessment and management system.

2. The establishment of an integrated coastal resources management plan for the Dahlak Islands Archipelago.

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3. The establishment of a regional multiple use marine resources management plan for the Dahlak Islands Archipelago.

Within the framework of these three principal objectives, the recommended project would produce the specific outputs or products outlined as follows:

1. The MMR will have established a statistical unit and a national fisheries information system. This unit will be staffed by field and office personnel that will have received the appropriate training to generate and monitor fisheries information. Through formalized training and on a day-to-day basis this unit will become familiar and competent in using current scientific and economic concepts of fisheries management. The unit will generate fisheries management plans that include Total Allowable Catches (TAC's) and be able to defend them persuasively relying on best available statistics.

2. The MMR will have established a comprehensive, operational, and enforceable fishery management plans for each of the management areas of Eritrea. These plans will ensure the sustainable development of Eritrea's artisanal and other fisheries resources so as to achieve the optimal fish harvest levels, maximizing over time the sustainable fish harvests, fisher employment, domestic fish consumption, and fish export foreign exchange earnings.

3. The MMR staff will have the technical capacity to continue the development and implementation of fisheries plans based on a program of stock assessment and the national fishery information system. The statistical unit in the MMR will carry on the collection, analysis and interpretation of fisheries data and generate information to guide policy decisions and the rational management of Eritrea's fisheries resources.

4. The MMR will have established a complete set of manageable and enforceable fishery regulations, including those on seasonality, area, gear, equipment, power, and other regulations on fishing, along with the establishment of total allowable catches for the various species and fisheries.

5. The MMR will have the necessary technology and infrastructure, including marine and computer equipment, required to support, to maintain, and to enforce a national fishery information system and fishery management system.

6. The leaders of the fisher communities, the Fishermen's Cooperatives, and the local government entities will be fully informed of the environmental and fishery regulations and will have established reliable and regular communication links with the MMR staff in charge of implementing and maintaining the national fishery information system and the fishery resource management system.

7. The MMR will have eight staff trained in communication and interpretive techniques to facilitate on-going community involvement in management plan decision making and monitoring. Eight staff will be trained in field operations of data collection and eight staff will be trained in data entry analysis and interpretation.

8. For the Dahlak Islands Archipelago, the MMR will have established a comprehensive fishery and marine resource monitoring, surveillance, and control system, and will have the trained personnel required to manage such a system, to ensure that illegal, destructive, or unsustainable fishing or other marine practices or activities are restricted to a minimum.

9. Eritrea will have a fully developed integrated coastal resources management plan for the Dahlak Islands Archipelago to guide optimal resource use and balance the conflicting interests of fishery, tourism, industrial, urban, and agricultural developments that impact on the environmentally sustainable development of the region. This can then be incorporated into the master plan for tourism development in the Dahlak Islands Archipelago.

10. Eritrea will have integrated coastal resources management plan guidelines for incorporation in the master plans and redevelopment efforts for the coastal town of Massawa, Hargigo, and the surrounding region, and the tourism development plan for Ghurguzzum.

11. Eritrea will have these coastal resources management plan guidelines for incorporation in the general guidelines and review process for integrated coastal zone management of the entire Eritrean coastline.

12. The MMR will have two staff, and other relevant ministries will have additional staff, trained in implementation of these coastal management plan and development guidelines in the review of development proposals and incorporation in development plans.

13. The MMR will have two staff, and other relevant ministries will have additional staff, trained about the means to reduce nonpoint sources of pollution (e.g., soil erosion, storm water runoff, leaching from cesspools, improper disposal of used oil and greases from repair shops and garages, and so forth).

14. The MMR and Ports and Maritime Transportation Authority will have draft pollution control measures to be incorporated into the expansion plans for Massawa and Assab port, and fuel depot areas.

15. The MMR and Ports and Maritime Transportation Authority will have relevant staff trained in basic pollution control techniques and enforcement methods for ports and harbors.

16. The MMR and Ministry of Mining, Energy, and Water Resources will have relevant staff trained in model general guidelines for pollution control for oil and gas exploration in the Red Sea.

17. The MMR, other relevant ministries, and provincial and municipal governments will have a prepared public educational campaign for raising public awareness of the citizens' role in protecting the marine environment.

18. The MMR, other relevant ministries, and the provincial and municipal governments will have staff trained in public education techniques and implementation strategies for this public education campaign.

19. The MMR will have a completed initial baseline survey of the Dahlak Islands Archipelago area, especially focusing on those areas that can potentially serve as fish replenishment areas, dive sites, environmentally sensitive areas, and habitats for flora and fauna of special significance.

20. The MMR will have had four staff members and six Eritrean Diving Association (EDA) divers trained in marine resource survey and water quality monitoring techniques through a series of two workshops.

21. The MMR will have an established regional marine resources management area with a multiple use zonation system defining the uses appropriate for different areas of the Dahlak Islands Archipelago which will ensure the sustainability of the artisanal fishery, assist in the proper management of the fishery resources, protect the biological diversity of the area, and provide for the optimal development of Eritrea's tourism industry in the Red Sea area.

22. The MMR will have the marine resources management area zonation boundaries accurately drawn on a master set of navigational charts, with a set of coordinates which describe these boundary lines.

23. The MMR will have the marine resources management area boundaries and use regulations prepared for enactment as law and regulations.

24. The MMR will have a Geographic Information System with mapped data layers of the Dahlak Islands Archipelago depicting the distribution of natural habitats, marine resource and environmental monitoring sampling sites and data sets, location and other data on sightings of marine mammals and sea turtles, areas

of environmental sensitivity, location, types and extent of human activities and resource uses on land and in the sea, and the marine resources management area zonation system.

25. The MMR staff will have the capability and training for providing surveillance over the marine resources management area and for maintaining and enforcing the management area regulations and guidelines.

26. The marine resources management area will be defined by appropriate markers and a system consisting of at least thirty mooring buoys will have been installed in appropriate locations as dedicated dive sites.

27. The MMR will have four staff and the EDA will have six divers training in selection of pin mooring buoy sites, installation and maintenance of a pin mooring buoy system.

28. The MMR will have four staff and the EDA will have six divers trained in education and interpretive program for marine conservation through a series of two workshops. This training will provide the skills for the effective design and functioning of the coastal conservation centers or other visitor centers in Massawa and on Dahlak Kebir.

7.4 Project strategy, organization, activities and milestones

This section presents the project strategy, explaining how the inputs will bring out the desired outputs. It addresses the issues of the organization and management of the project. Finally, it presents a detailed analysis of the elements of the project activities, their timing, and milestones of accomplishment.

7.4.1 Project strategy

The overall project is a three year effort that combines three components: fisheries stock assessment and management, integrated coastal resources management, and regional multiple use marine resources management. The fisheries stock assessment and management component will include short and long term technical assistance and training in all three years. The coastal resources management component will have short term technical assistance and training in all three years, and long term technical assistance in years two and three. The multiple-use regional marine resources management component will have short term technical assistance and training in all three years.

The core of the project is to build the skills and capabilities to gather and utilize the necessary information for managing the sustainable development of fisheries

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resources. There is significant pressure to develop this fishery rapidly, so the effort to build the data base and the related analytical skills and tools must be mobilized just as rapidly. This project will provide the necessary technical assistance and training required to establish and maintain such a fishery stock assessment and management system.

The Eritrean Ministry of Marine Resources has committed itself to sustaining the biological productivity of the marine resources by maintaining the growth and reproductive capacity of the fishery resources, and the productivity of the marine environment itself (DMRIF 1993a). The coastal resources management component and the marine resources management component are directly related to sustaining the fishery resource by developing and implementing the management tools to protect the habitat and environment in which the fishery resources live.

Coastal resources management is the overall framework of managing the coastal resource use on land and in the sea, in a manner that can sustain the resource base in terms of fish stocks, coral reef, sea grass and mangrove habitats, beaches and water quality. The linkages between the land and sea within the natural coastal ecosystem are multiple and complex. Carefully designed guidelines and development plans can provide the tools for sustaining a fisheries industry, tourism industry, and cultivating and maintaining a high quality of life for the local population.

The strategy is to build the process skills for developing a coastal resources management plan by focusing on the Dahlak Islands area first. This area is selected since it is the major fishing grounds for Eritrean fishers, and the site for potentially substantial future tourism growth. It is a relatively discrete area with minimal existing conflicts, and the potential for significant long-term conflicts. In short, the islands present a suitable place to start building the expertise in coastal resources management within the proposed Integrated Coastal Zone Management (ICZM) Department of the Ministry of Marine Resources. After a start here, the ICZM Department will be better able to work with the urban planning efforts on the mainland coast. The ICZM Department can use the same framework of coastal zone management for reviewing proposed projects and the same guidelines for managing the development of different land and coastal water uses, including residential, industrial, tourism, mineral extraction, and forestry.

To complement this integrated coastal resources management plan for the Dahlak Islands Archipelago, a multiple use management plan will be developed for the marine area itself. This multiple use marine resources management area is an effective management tool that will be applied to the island area along with the coastal resources management plan. This regional marine resources management area will provide the means for protecting specific areas for non-fishing marine reserves for fish replenishment, outstanding dive sites on coral reefs for a sustainable dive tourism

industry, and habitat for flora and fauna of special significance. Marine reserve areas serve an essential scientific purpose as they are the control against which could be measured the effects of different types or intensities of fishing pressure. The marine resources management plan also identifies multiple use areas where other activities, including consumptive or extractive uses, such as fishing and oil and gas extraction, can take place.

7.4.2 Project organization and management

The role of the team leader, in addition to the task of organizing a stock assessment program for the Ministry of Marine Resources (MMR), will be to administratively coordinate the objectives of the training components, the coastal zone planning components, and the marine resources planning components of the entire project. The team leader will act as the chief liaison between the recipient of assistance (MMR) and the in-country international donor representative, as well as with the project staff. It is the responsibility of the team leader to see that the program proceeds according to schedule, propose realistic modifications, and seek project staff assistance or supplies when necessary.

Concerning the fisheries stock assessment and management component of the project, coordination of these activities will also fall under the specialty and responsibilities of the assigned team leader. As the Fishery Stock Assessment and Management Specialist, the team leader must design and administer a fishery data gathering program which will satisfactorily address the needs of the MMR and other coastal agencies as well as supporting the sustainable development of the Eritrean marine resources. This will involve analyzing past and existing fishery data collections and investigations in addition to the development of a new data collection format and procedures. An initial part of this task will be to assist in the selection of MMR staff for the data gathering portions of the projects, setting up a computer network and data base system and files in which to store acquired data, and oversee the data collection process. Staff and counterpart training will be an on-going process throughout the tenure of the fishery stock assessment specialist and project. The quality of needed training in stock assessment techniques and procedures will be determined by the specialist. Either through individual or formal teaching methods, the technology transfer will be accomplished. Along with guidance from the MMR, it will be the responsibility of the stock assessment specialist to plan and coordinate the wisest use of 420 specialist days of short-term technical assistance and training over three years which the project provides, to best serve the needs of the MMR and the fishery stock assessment program.

The responsibilities of the Coastal Resources Management Specialist is to analyze available resource management information generated by previous data gathering investigation such as the Global Environment Facility (GEF) and assist the MMR in

coordinating with other Eritrean agencies in the development of coastal management policies and plans which will allow for the wise and sustainable development of Eritrea's coastal and marine resources. A major component of this two year program of technical assistance will involve assistance to the MMR and other participating government agencies in the creation and administration of a regional marine resources management plan for the multiple uses of the Dahlak Islands Archipelago. As with the stock assessment component of the overall program, counterpart and staff training are on-going tasks for the Coastal Resources Management Specialist throughout the two year tenure. Within this component of the project, 280 specialist days of short-term in-country technical assistance and training over three years for coastal resources management, and 280 specialist days of short-term in-country technical assistance and training over three years for marine resources management will be allocated by the Coastal Resources Management Specialist, in coordination with the Team Leader and the MMR.

The Contractor's home office will act as the administrative support and agent for the entire program. They will provide necessary project personnel, state-side administration, facilitate technical and training assistance, as well as programmatic support required by the project. The home office will serve as liaison for the project with the international donor contracting office.

The day-to-day administration of the project will be the responsibility of the team leader in Eritrea. The team leader will prepare work plans, schedule tasks, define the terms of reference for the short-term trainers/specialists over the three year duration of the project and ensure that these tasks are carried out. Whenever asked, the leader also acts in an advisory capacity to the MMR on fisheries management issues. The team leader will also be responsible for the financial management of the project. As donor assistance to Eritrea changes in scope and targets, the team leader will co-operate with the other donor agencies to avoid duplication of effort and will seek complementarity in donor assistance. The leader will coordinate the training, both in groups as well as individually, those staff assigned by the MMR to the various components of the project.

The team leader will also be responsible for coordinating the activities of this project with the other related donor-assisted projects in Eritrea. The two primary projects with which close coordination will be necessary is the UNDP/FAO Semhar-Assab Fisheries Project, and the Global Environment Facility (GEF) coastal conservation project. In many cases, joint workshops, field survey expeditions, boat and aerial surveys, and other activities will make the best use of limited resources. The annual work plans should be carefully coordinated with the other programs' annual work plans to coordinate scheduling of such activities. In addition to the two large projects already mentioned, the team leader should work to collaborate and coordinate with several additional projects such as those funded by the governments of Italy, Japan,

and United Kingdom, and by nongovernmental organizations such as the Urk-Interchurch Foundation, Oxfam-Canada, and projects such as the Aldo Jacober tourism planning project, and the private Italian diver training programs.

7.4.3 Detailed analysis of project activities and their timing

7.4.3.1 Fisheries stock assessment and management component

Long term technical assistance is to be provided by a fisheries stock assessment and management specialist over all three years. This specialist will also serve as the team leader for the project. Responsibilities will include designing the plan for establishing a stock assessment and management system within the Ministry of Marine Resources (MMR). This will require designing the data collection and processing system for catch assessment survey, effort data, boat and gear surveys, frame surveys, and other means of gathering information on the fishery such as market surveys. It also requires coordinating the set up of the computer systems, and data entry and analysis programs. In addition, the leader/specialist will coordinate the training of local staff in interview and data gathering techniques, data entry, and analysis.

Some of the training will be carried out in workshops conducted by a specialist/trainer that will come in for short term visits four times each of the three years. These workshops will focus on: training in basic fisheries concepts, quantitative methods and procedures in data collection, entry, processing. The goal is to create a cadre of fisheries workers who are competent in all aspects and steps of the process.

Year one objectives for the specialist/leader are:

1. Identify the criteria and justifications for and define the Eritrean coastline, territorial waters and the Dahlak Islands Archipelago into fisheries management areas.

2. Conduct an initial survey, with the aim of producing thematic maps of the fisheries management areas that have the primary and secondary landing points and all other points relevant to fisheries such as boat distribution, freezers, cold stores, retail markets, processing plants, transportation routes, industrial trawling grounds, shipping lanes, marine resources management area zones such as conservation zones, research zones, gear-specific zones, rotating fishery zones, and areas where only traditional fishermen can harvest.

3. The above thematic map and all the relevant points and areas constitute the framework which needs to be surveyed. Procedures for the Frame Survey will be based on and adapted from those developed by FAO (e.g. Guidelines for Statistical Monitoring, FAO Fisheries Technical Paper No. 257 (Caddy and

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Bazigos 1985)). This part requires significant amounts of field work for extended periods of time.

4. Produce a conceptual framework for the fisheries information system in collaboration with other interested parties like the Research Division and Coastal Zone Management Division of the MMR. Define Primary Sampling Units (PSU), along with the stratification and the procedures for cross checking.

5. Train the manpower available in procedures of data collection, i.e. train enumerators in the field. Specific training for women enumerators and data collectors who will focus on collecting data from women fishers will be conducted. As part of this process, improve the design of data forms.

6. Using the sampling frame and the inputs described above in #4, design a Catch Assessment Survey (CAS) that quantifies catch, effort and gear characteristics and displays their spatial and temporal distribution.

To complement these efforts, three workshops will be conducted in year one by a specialist trainer that will focus on the following:

Workshop 1-1

This will be dedicated to design and preparation of electronic and paper forms, and creation of the databases that will hold the figures.

Workshop 1-2

This will be a collaborative effort between the team leader and a programmer to write data entry screens, error trapping routines, and verification programs. Programs for analysis and routine summary generation will also be written and debugged collaboratively for processing the various databases.

Workshop 1-3

This will repeat elements of Workshop 1-2, expanding to other aspects of fisheries data like market data, fleet operations data such as cost/earning survey data, economic data, and export data. Design and testing of electronic and paper forms will also be accomplished, and the necessary entry programs will be written.

Workshop 1-4

Basic fisheries statistics, theory and practice will be explained. The workshop will address how and why to compute various descriptive statistics, i.e., distributions, mean, variance, hypothesis testing, representative samples, statistical bias, random sampling, and various distributions.

Year two objectives for the specialist/leader are:

1. Oversee and carry out of the Frame Survey during initial 3 months.

2. Oversee the process of entry and processing of all the data generated by the Frame Survey.

3. Oversee the enhancement of local capacity for various aspects of the tasks and designing the content and pace of workshops allocated to the second year.

4. Identify bottlenecks in the regular functioning of the data collection and processing system and address them by responding with workshop training design that responds to the gaps.

To complement these efforts, four workshops will be conducted during year two by a specialist trainer that will focus on the following:

Workshop 2-1

Basic elements of fisheries population biology will be explained, for example, surplus production models, stock-recruitment models, length frequency models and their data requirements. This workshop will also cover parameter estimation for various models and explain what they mean.

Workshop 2-2

This will focus on management in the real world, including discussion of licensing as a means of limiting entry, various kinds of licenses, quotas system, ITQ's and the advantages and disadvantages of each of these. The participants will be challenged to determine what would work or would not work in Eritrea, and why.

Workshop 2-3

This will focus on the fisheries sector in Eritrea as it is imbedded in a regional ecosystem and economy. Discussion will explore how macro-economic policies can penalize one sector and favor another one.

Workshop 2-4

This will concentrate on ecological economics and fisheries development, including discussion of exporting of raw primary products versus products with value added. This workshop will use data collected by the fisheries information system, including economic data, and see how well participants can respond to ad hoc questions.

Year three objectives of the specialist/leader are:

1. Ensure that the fisheries information system is functioning routinely and reliably. This means that fisheries statistics of various kinds are either released on a periodic basis or that they are available upon request.

2. Focus on those few individuals who have shown promise and aptitude over the preceding two years for technical, field or managerial skills and, on a daily basis, train them to take over various aspects of the work.

3. Establish an internal tutorial/training system for workers to advance and progress through the ranks.

4. Establish a system for rotating individuals among various tasks so they may be able to accomplish a variety of jobs as they are needed.

To complement these efforts, four workshops will be conducted in year three by a specialist trainer that will focus on the following:

Workshop 3-1

The basics of fisheries economics will be addressed, including discussion of the common property nature of fisheries, bio-economic equilibrium, dissipation of rent and how classical management responds with various controls. Input controls, such as season, boat size, gear restrictions etc. and how fishermen circumvent them will also be covered, as well as output controls like taxes, and their application in various circumstances.

Workshop 3-2

Comparisons of different types of management will be covered, for example, open loop versus feedback control type, and passive adaptive versus active adaptive management. Some techniques that will be explored include adaptive probing policies and setting up of management regimes so that knowledge can be gained about the effect of harvesting on the natural production of the marine ecosystem.

Workshop 3-3

The goal of this workshop is to produce and present a simulation model of one or more of Eritrea's fisheries and use the graphic output as a tool to explore visually the outcome of various policy choices. This workshop will be for senior MMR personnel and will focus on the need for types of information and their use and how this information could be collected.

Workshop 3-4

This will be a repetition and expansion of Workshop 3-3 that will deal with constructing a fisheries production model that is imbedded in a national and a regional economy. This will help senior MMR personnel use simulation technique as a projection tool for outcomes of various policies.

7.4.3.2 Coastal resources management component

In year one, the development of skills and experience in coastal resources management within the Ministry of Marine Resources will be initiated through a short term technical assistance project. This will focus on meeting the immediate needs of the ministry for appropriate general principles of integrated coastal zone management for the purposes of assisting in developing national coastal zone management policy; and preliminary general guidelines for tourism, industrial, urban, and agricultural use of the coastal lands. This will be useful and timely for the ministry in addressing the pressing needs of reconstruction and development of the coastal area.

In year two, long term technical assistance will commence with a coastal resources planner being mobilized to Eritrea. At this time, the Ministry of Marine Resources will have identified, hired and assigned a local counterpart to the Integrated Coastal Zone Management (ICZM) Department of the Ministry as the MMR coastal resources planner. It must be noted that it is essential to train female staff of the MMR so that they understand the principles and process of coastal resources management, and the multiple use marine resources management system. With this knowledge, they can then be instrumental in involving the women and children of the island villages in the management plan development process. The objectives for year two of technical assistance will be to:

1. Analyze the data gathered by the Global Environment Facility (GEF) "Eritrean Coastal Conservation Project" and identify any data gaps regarding uses and characteristics of islands, reefs, shoals, and surrounding marine resources of the Dahlak Islands Archipelago.

2. Conduct surveys of those areas not currently surveyed, especially focusing on those areas that can potentially serve as fish replenishment areas, dive sites, environmentally sensitive areas, and habitats for flora and fauna of special significance. This will be done in conjunction with the first workshop of the marine resources planning specialist/trainer.

3. Characterize the use patterns for the Dahlak Islands Archipelago land and water areas, including areas used for fishing, gathering, and potential areas for tourism, military, residential and oil and gas development.

4. Prepare specific guidelines for managing this development.

5. Identify those areas that will serve as popular dive sites and select specific sites for installation of pin moorings for surface mooring buoys, and install buoys at these locations. This will be done in conjunction with the second workshop of the marine resources planning specialist/trainer.

6. Develop a preliminary coastal resources management plan and a multiple use marine resource management plan for the Dahlak Islands Archipelago including a zonation system incorporating those areas previously designated in year one as marine reserves where fishing and gathering have been prohibited. This will be done in conjunction with the first workshop of the coastal planning specialist/trainer. It is essential to train female staff of the MMR so that they understand the principles and process of coastal resources management in order to pass this on to the affected villagers.

7. Develop a review process for coastal tourism development proposals for the island area. Training in the implementation of this process would be done in conjunction with the second training workshop of the coastal planning specialist/trainer.

8. Develop a close cooperative working relationship with the local community throughout this process. To strengthen relevant skills in the department, the third training workshop of the coastal planning specialist/trainer will focus on ways to facilitate local community involvement in the planning process. It is essential to train female staff of the MMR in order to build the capabilities to link with the women in the local community.

To complement these efforts, three workshops will be conducted in year two by a specialist trainer that will focus on the following:

Workshop 2-1

This will focus on designing zonation systems for coastal planning with an emphasis on fisheries conservation. The workshop will include going through the process of evaluating the resource inventory data base, human use profiles and other data, and selecting a preliminary zonation system.

Workshop 2-2

Management tools for coastal tourism developments will be explained in this workshop. The participants will work through a technical review process for a coastal hotel or bungalow development proposal.

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Workshop 2-3

Tools to facilitate local community involvement in the planning process is the focus of this workshop. These include clarifying and simplifying the logic of benefits from coastal resources management and marine resources management to the local villagers, interview and meeting techniques, and developing visual aids and interpretive material for use in the local communities.

In year three, the coastal planner will broaden the scope of the ICZM Department of the Ministry of Marine Resources to focus on coastal management issues being faced in the Massawa area and surrounding coastal region on the mainland. This will be done in conjunction with UNDP and USAID sponsored urban planning efforts that would be underway at this time. The objectives of year three include:

1. Develop coastal management measures for incorporation the in urban reconstruction and development plans for Massawa and Hargigo.

2. Develop coastal management measures for incorporation in the tourism master plan for Ghurguzzum and other areas.

3. Develop measures to reduce nonpoint source pollution (soil erosion) for incorporation in the agriculture development plan for the coast.

4. Train planners in the different relevant agencies about means to reduce nonpoint sources of pollution (soil erosion, storm water runoff, leaching from cesspools, and improper disposal of used oil and greases from repair shops and garages). This training would be in conjunction with the second workshop of the coastal planner specialist/trainer.

5. Develop pollution control measures for incorporation in the expansion plans for Massawa and Assab port, and fuel depot areas. Training of the local officials and staff of relevant ministries would be done in conjunction with the third workshop with the coastal planning specialist/trainer.

6. Develop general guidelines for pollution control for oil and gas exploration in the Red Sea. Training of the local officials and staff of relevant ministries would be done in conjunction with the third workshop with the coastal planning specialist/trainer.

7. In order to address the critical need to raise public awareness of their role in protecting the marine environment, a public education campaign would be developed. To assist in this effort, the fourth training workshop of the coastal planning specialist/trainer will provide training in the necessary skills and techniques to carry out this campaign. As discussed above, the training of

female staff of MMR is essential to reach the women and children in the local population.

8. There are several objectives in year three regarding the marine resources management area which are described below in section 7.4.3.3.

To complement these efforts, four workshops will be conducted in year three by a specialist trainer. These workshops will be conducted to build the expertise among the planners within several government agencies including the Ministry of Marine Resources; Ministry of Finance and Development; Ministry of Trade, Industry and Tourism; Ministry of Mines, Energy, and Water Resources; Port and Maritime Transportation Authority; Ministry of Provincial Administration; the coastal provincial governments; and the municipal governments of the coastal towns. As discussed above, it is essential to train female staff of these ministries in order to build the capacity to educate, interpret, and raise awareness of these coastal resources management measures among the women in government, private sector, and the communities. These workshops would focus on the following areas:

Workshop 3-1

This workshop will focus on incorporating coastal planning measures in urban and regional planning, using as examples, the master plan development of Massawa and the tourism plan for the Massawa region.

Workshop 3-2

Management techniques for reducing nonpoint sources of pollution will be covered including those related to agriculture, urban development, household wastes, and wastes from small-scale industrial activities, such as mechanical repair garages or service stations.

Workshop 3-3

Pollution control for oil and gas transport, storage, and production will be the focus of this workshop. This will cover ports and harbors, and the measures they can take to control pollution, and steps to take to be prepared for accidental spills.

Workshop 3-4

This workshop will focus on public education in marine environmental protection. Participants will be taught skills and techniques for public education, and will work together to design a public education campaign for Massawa and Dahlak.

7.4.3.3 Marine resources management component

The development of a multiple use management scheme for the marine area of Dahlak Islands Archipelago is a step-by-step process. First, there is an immediate need to establish marine reserves, where no fishing is allowed, within the Dahlak Islands Regional Marine Resources Management Area. These areas are ones that through preliminary survey work present the best potential as fish recruitment or replenishment areas.

During year one, a short term technical assistance specialist will be sent to work with the Ministry of Marine Resources (MMR) Department of Marine Research and the Fisheries Specialist/Team Leader to identify these areas within the Dahlak Islands Archipelago, including the reefs and shoals extending north to Saunders Reef. The specialist will also work with the MMR to initiate discussions with the local fishing community as to the needs and benefits of setting aside these areas, and establish these non-fishing reserve areas. It will be important to include female staff from the MMR on this project so that there is a capability to communicate with the women in the local island villages and involve them in the planning process.

This assistance project will take place after the fisheries technical assistance has already been initiated, and well after the Semhar project will have begun to increase the efficiency and catch per unit effort of the artisanal fishermen. In this way, the island fishermen will better appreciate that to sustain this higher level of catch, some nursery areas need protection. It is essential that the local community be involved with and support the establishment of these protected areas.

During year two, the coastal planning component is closely integrated with the development of the marine resources management area. Consequently, the project strategy for the marine resources management area is described above in section 7.4.3.2. To complement these efforts, four workshops will be conducted in year two by a specialist trainer that will focus on the following:

Workshop 2-1

Marine environmental survey techniques will be covered. This includes basic underwater transit and census techniques for fish, coral and other bottom environments. The techniques using indicator species for monitoring purposes will be covered. Basic survey and data collection forms will be explained. Basic water quality sampling and analysis will also be covered. These skills will then be practiced on several marine and coastal surveys of islands in the Dahlak Islands Archipelago.

Workshop 2-2

Installation and maintenance of pin mooring buoys is the focus of this workshop. Basic design, hardware, site selection, installation and maintenance of the buoys will be covered. The class will then go in the field to inspect existing mooring pins and buoys, select additional sites, and install several mooring pins in the seabed.

Workshop 2-3

Marine resources management and enforcement techniques are the focus of this workshop. It will cover basic principles of marine resources management, as well as day-to-day operations in monitoring and enforcement. Female staff should be trained in these skills in order to be able to work with the women in the island communities.

Workshop 2-4

Interpretation and education techniques are the topic of this workshop. Tools and techniques, as well as basic content of education and interpretive programs will be covered. As described above, it is important to include female staff of the MMR in this training to build the capacity of reaching the women and children of the local community.

During year three, the coastal planning component focuses more broadly on coastal management issues in Massawa and on the mainland coast as well as the islands. These coastal planning objectives are described above in section 7.4.3. Regarding the marine resources management, the coastal planner has several objectives to accomplish in year three. As discussed above, it is important to train female staff of the MMR in marine resources management. Because of the critical role women and children play in marine resource use of the archipelago, it is essential to be able to work with them and involve them in the planning process. In addition to the objectives listed above in 7.4.3.2, in the third year the coastal resources planner will continue to:

1. Work on the development and further establishment of the Dahlak Islands Marine Resources Management Area by continuing efforts in conjunction with the GEF team in identifying those areas that can potentially serve as fish replenishment areas, dive sites, environmentally sensitive areas, and habitats for flora and fauna of special significance.

2. Gather further information on the various human uses of the area, and further refine the multiple use zonation system for consumptive and nonconsumptve uses. The planner will work to supplement information in the charts and data bases developed by the Ministry of Marine Resources Department of Marine Research.

3. By the end of year three, a comprehensive regional marine resources multiple use management system is to be completed with designated zonation, rules and regulations, boundary markers, staffing, and equipment.

4. To further assist this on-going process of surveying the island's resources, the third year's first workshop of the marine resources management specialist/trainer will focus on advanced techniques for marine environmental surveys and monitoring.

5. Because of increased use of the management area by visitors to the islands by live-aboard dive vessels, those staying on the islands, and day-trippers, further training in management and enforcement techniques will be useful. This will be the focus on the second workshop of year three with the marine resources management specialist/trainer.

6. The coastal planner will assist the MMR and Eritrean Diving Association, in the completion of two interpretive centers for coastal conservation in conjunction with the GEF team. The third training workshop will complement this effort with its focus on interpretive and educational techniques.

To complement these efforts, four workshops will be conducted in year three by a specialist trainer that will focus on the following:

Workshop 3-1

More advanced marine environmental survey techniques will be covered. This includes additional training in underwater transit and census techniques for fish, coral and other bottom environments, and use of indicator species for monitoring purposes. Basic survey and data collection forms will be reviewed. Additional training in basic water quality monitoring will also be covered. These skills will then be practiced on several marine and coastal surveys of islands in the Dahlak Islands Archipelago.

Workshop 3-2

More advanced marine resources management and enforcement techniques will be the focus of this workshop. It will review the basic principles of marine resources management, as well as cover day-to-day operations in monitoring and enforcement. Issues that have arisen over the past year's experience will be covered.

Workshop 3-3

Advanced interpretation and education techniques are the topic of this workshop. Additional tools and techniques, as well as a review of the basic content of education and interpretive programs will be covered. The past

year's experience in interpretive and education programs will be reviewed and plans for the next year will be developed.

7.4.4 Project milestones and accomplishments

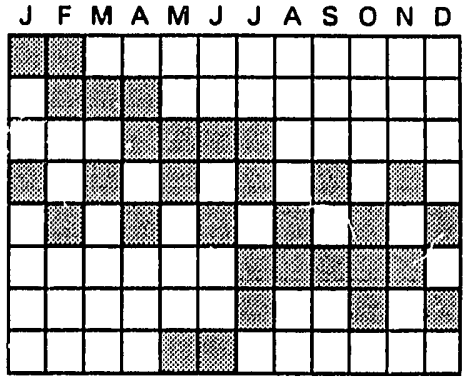
This section presents a detailed schedule and timeline of activities, noting key events and accomplishments along the way to the final project objectives.

Table 7-1 Schedule of recommended project activities.

Fisheries Stock Assessment and Management

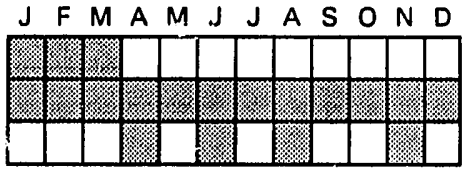
YEAR 1

1. Identify Areas of Statistical criteria.
2. Survey/identify/map sampling points.
3. Design data base/forms
4. Recruit/train field staff
5. Recruit/train computer staff
6. Design catch assessment survey
7. Training Workshop
8. Technical Assistance



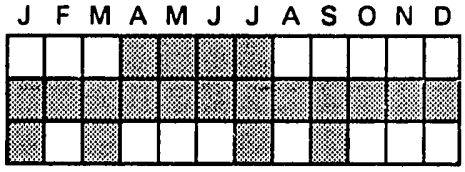
YEAR 2

1. Frame Survey
2. Continue data collection
3. Training Workshops



YEAR 3

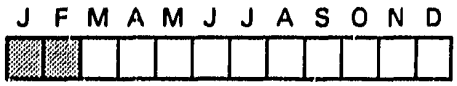
1. Frame Survey
2. Establish internal tutorial
3. Advanced Training Workshops



Coastal Resources Management

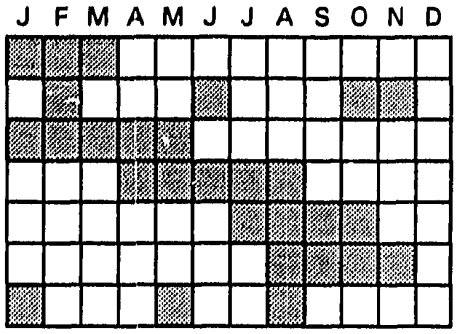
YEAR 1

1. Technical Assistance



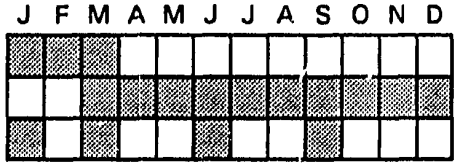
YEAR 2

1. Analyze data GEF
2. Conduct surveys
3. Review development sites
4. Prepare management guidelines
5. Develop management plans
6. Review development proposals
7. Training Workshops



YEAR 3

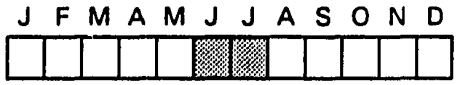
1. Coastal management plans
2. Pollution control measures
3. Training Workshops



Marine Resources Management

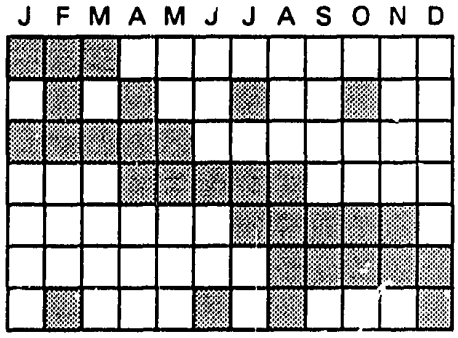
YEAR 1

1. Technical Assistance



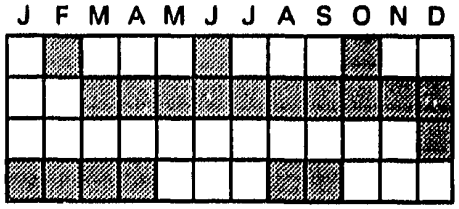
YEAR 2

1. Analyze data GEF
2. Conduct surveys
3. Review development sites
4. Prepare management guidelines
5. Develop management plans
6. Review development proposals
7. Training Workshops



YEAR 3

1. Additional marine surveys
2. Refine zonation system
3. Complete park management plan
4. Training Workshops



7.5 Human resource requirements and constraints

This section will deal with issues concerning Eritrea's human resource requirements and constraints, with a particular focus on the relation of these human resource requirements and constraints and the development of Eritrea's coastal and marine resources. A general examination of the condition of Eritrea's vocational and technical education system will be followed by a brief examination of the proposal to establish a Marine Technology Training Center at Hargigo. This is followed by a discussion of the role of women, and the need for specific training of women, in the coastal and marine resources sector.

7.5.1 Strengths and deficiencies of Eritrea's technical training system

Although the communities and infrastructure of Eritrea may be in shambles, the country and people have been blessed with many unique qualities which will lead to their success as a nation. The country's greatest asset is the people themselves. Coming out of a victorious war for independence, Eritreans exhibit a strong sense of community responsibility, self-confidence, and a desire to rebuild their country. In addition, there is a historical familiarity with modern technology. This technological familiarity stems largely from the period of Italian occupation. However, even during the war, an entire generation survived, endured and succeeded by salvaging and repairing captured or destroyed equipment and supplies. Actions like these reveal that there is a cadre, even if not large, of knowledgeable and at least semi-trained technical talent available which is willing to work and learn new skills. These are important abilities which will be needed to rebuild Eritrea.

Eritrea had in the past and still has a capable education system, even if it is not widely available. Although illiteracy is still phenomenal high in the countryside, primary and secondary education are available throughout the country for many of the most able students. Advanced education is available at Asmara University. Prior to the end of the war, the student body was a mix of Eritreans and Ethiopians, but now the students are all Eritrean. At present there are 32 third-year students in the biology department. The course curriculum is offered in the disciplines of general and marine biology, and practical analysis techniques are stressed. Therefore, in two years,

conservatively, there could be as many as 20 to 30 university trained personnel available to the MMR, health, and other ministries which require environmental analysis testing procedures and interpretation.

Vocational and technical training is offered at the Technical School in Asmara and at the Wena Technical School in Nakfa. The Technical School in Asmara has been operating since 1957 and has graduated over 3000 Eritrean and Ethiopian students. At present the all-Eritrean student body consists of 426 students enrolled in day classes and 415 continuing education students enrolled in evening classes. Day classes are offered to screened and selected 9th grade students while evening classes are offered to motivated high school graduates who wish to obtain job skills. Since the evening courses were begun in 1984, the school has graduated 825 students from the program. Course work and hands-on training are offered in general mechanics, auto/diesel mechanics, drafting, woodshop, and electricity. The Wena Technical School was begun by the Eritrea Peoples Liberation Front (EPLF) during the war as a means to continue the education of the young fighters. The school is still operating and, although not as large as the Asmara Technical School, it presently has about 300 students. The curricula are the same for both schools, except that the Wena school can board students. At both schools, students attend at their own expense, without government support. The day program is said to have about a 98% graduation rate, while the graduation rate for the evening program is about 60% because students will leave when they are offered a job. These statistics imply that there is in fact a ready, if small, supply of technically trained personnel available to be quickly retrained for specific technical jobs.

Yet, even with the availability of primary and advanced training, there are training deficiencies within the MMR and other Ministries. Some of the obvious deficiencies which were observed related to the depth of trained personnel which staff Ministry departments, the availability of experienced personnel, and displaced disciplines of training (e.g., a person trained as an architect may have the responsibility of a community planner). The talent present in Eritrea's upper level of government differs greatly from many developing countries in that almost all positions of responsibility are filled by people who have been trained in their disciplines of responsibility and most have experience within that discipline.

The MMR is much like other ministries in that its officials recognize the inadequacies in the number and quality of trained staff, yet are frustrated in their attempts to find a solution to the problem. Within the MMR, the problem of acquiring trained staff is very real. Many fighters during the war missed out on getting the education and training now required of them. Numerous staff positions remain unfilled because trained personnel can not be recruited. An issue which compounds this problem is that trained (or trainable) personnel may be available in Asmara in the highlands, but may be unwilling to transfer to Massawa on the coast, where the MMR will soon

relocate. Even now, the MMR must pay a 40% salary differential for personnel base in Massawa, the so-called "heat allowance." Another training constraint lies in the important need for trained specialists. The MMR is in the crucial phase of designing the foundation of a sustainable development program for the Eritrean marine resources. Expert advise is needed now. Most of these specialties are not available in the country, and expensive specialists must be acquired from abroad. Furthermore, such specialists are often faced with the added tasks of training their counterparts in the country who many times are participating in out-of-country advanced training programs. By the time the counterpart returns from training, the expatriate specialist is about to leave and the inexperienced counterpart inherits the entire program without benefiting from the specialist's experience. These problems are not limited to the MMR, but are common throughout all ministries.

The formal training facilities also have their limitations. The Asmara University marine biology department has only four instructors, none of whom hold Ph.D. degrees and only two of whom hold M.Sc. degrees, with the other two having B.Sc. degrees. This constraint limits the quality and level of the education offered and the number of students which can be trained. Furthermore, textbooks, training materials, and supplies are limited, largely because of budgetary reasons. For example, only three microscopes were observed in the student training laboratory. As an added difficulty it should be noted that the University enrollment has been closed to freshmen for the 1993-94 session due to an insufficient number of instructors, and University may not even open in the fall due to a shortage of operating funds.

The Technical School in Asmara suffers with similar problems. The school was originally built in 1957 and operated with major support from the United States. Through the 1960's, the U.S. Peace Corps participated significantly, supplying many school instructors. In 1972, the United States ceased all involvement with the school, and, for the most part, the buildings, tools, and training aids have not been replaced or repaired since the U.S. ended its support. The lack of maintenance and modernization has not been due to negligence of the school training staff, but because of the former regime, the war, and a universal lack of funds. As with the University of Asmara, there is a general need for modern textbooks explaining current technology, and modern tools and testing equipment on which to train students for today's technology. Student project material and supplies, for example, welding supplies, metal, wood, etc., are expensive and their availability limited. More skilled instructors are required to broaden the scope of training. For example, no qualified instructors are available to teach needed courses in refrigeration and cooling systems. Courses in electrical wiring were only recently offered, when a qualified instructor was found. A final constraint is that the location of the school confines the major enrollment to the Asmara area. Because student enrollment is not subsidized, only a few of the students from the rural or coastal regions are able to attend. At present, only one enrolled student is from the Assab area, yet the coastal regions have a

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tremendous potential for growth and redevelopment as well as a great demand for technical skills.

Eritrean officials have emphasized their needs for skilled labor and for internal staff training. During the RDA Team facilitated workshop, participants repeatedly identified as a priority the training of men and women in the areas of tourist service/catering, refrigeration, fish processing, agricultural and fisheries extension techniques, boat building and repair, navigation, fishery/marine enforcement, and nutrition. Specifically, training centers were proposed for the MMR, the tourism industry, and port operations.

7.5.2 An evaluation of the Hargigo marine technology training center proposal

One specific vocational training center proposal warrants particular attention. This is the MMR proposal to establish a Marine Technology Training Center at Hargigo, near Massawa. The proposal has been submitted to both British and U.S. international donor agencies for review and possible funding. Following a thorough investigation and much discussion and thoughtful consideration of this proposal, the RDA Team concluded that it would not recommend the immediate establishment of a sole-purpose Marine Technology Training Center at Hargigo. There is certainly a need for vocational and technical training program in the marine technology area that is conducted as part of a comprehensive technical training program. However, Eritrea has more immediate needs than can be addressed by the current establishment of a training center with the sole focus on marine technology. Several years from now, after the MMR has indeed moved its operations from Asmara to Massawa and finally to Hargigo, after the city of Massawa has been reconstructed and repopulated, after the infrastructure at Hargigo has been rebuilt, and after Eritrea has met some of the more immediate requirements of reconstruction from the devastation of the war, then the development of a Marine Technology Training Center at Hargigo may be a cost effective, feasible, and desirable development activity.

It should be immediately noted, however, that Eritrea and the MMR does indeed have a need for a marine technology training facility in the Massawa area. Such a facility would include a building with classrooms and perhaps laboratories with facilities in which various training programs in marine and coastal resource management, including fisheries technologies, could be conducted. There are indeed well identified skills and training gaps in marine technology. Much training is required. However, establishing a vocational training school specifically focused on marine technologies does not appear to be warranted at this time.

The supply of trained personnel who would be produced from such a proposed training center must be examined in the context of the potential demand for such skills which currently exist or may arise during the next decade or so. The proposed

MMR Marine Technology Training Center to be located at Hargigo is a well planned and ambitious training facility. The proposed curriculum rivals that of functioning marine technical schools in developed countries. The proposed funding is requested for two years or until two classes of students graduate. However, once two classes have graduated, there will be approximately 75 skilled employable Eritreans trained in the disciplines of vessel operation and navigation, fisheries techniques, refrigeration, aquaculture, boat building and vessel repair, and marine business management. It is most likely that the 75 trained persons could fill current research and extension staffing needs in the MMR, in the redevelopment Port of Massawa, and in the development of fisheries infrastructure and marketing facilities. However, continued matriculation of additional classes of marine technology trainees at this scale does not appear to be warranted under current conditions.

Furthermore, the costs of the training center are hardly warranted unless they can be amortized over many graduates over many years. For example, at the projected training center costs, the cost per student for the first 75 graduates would be US$81,247. If a long term demand for such skilled labor could be identified, one could amortize the cost of the facility over a greater period of time and realize a much lower cost per student. Considering a 10 year training operation, producing a 338 graduates and maintaining technical assistance over the first 6 years of the program, the cost per student would drop to US$23,447. The above costs are by no means excessive when one realizes that cost per student in the United States for primary school through university graduation can approach US$300,000. However, the costs are very high in the context of the Eritrean economy.

The important question to be considered relates to the realistic long-term demand for such formal training centers and to the cost effectiveness of establishing a center at Hargigo as compared with alternative methods of achieving the intended goals. Often, the long and short-term formal training needs can be confused with immediate labor skill demands. Prospective students are recruited to attend two year or longer training programs with the perception of key employment positions on graduation. Unfortunately, the perceived key positions are immediate employment opportunities which must be filled as quickly as possible with the best available talent. Students return to the job market following their training only to find positions filled and frustration sets in because they are over qualified for existing employment and the only advancement potential is based on natural attrition. The Hargigo training center faces the additional problem that many of the trainees are likely to come from the highlands and may not want to remain on the coast after their training has been completed. Considering the low population densities, and the low literacy rates, in the hot coastal region, and considering that the major city of Massawa currently has only a quarter of its earlier population, it is likely to be difficult to find qualified applicants to fill the first few classes of the proposed Hargigo training center. Many students

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who come from the highlands are likely to leave the coastal area following training.

The described scenario will not necessarily happen, but it has occurred in many similar situations and in many other countries. On the other hand, if there is a rapidly growing industrial labor market, employment opportunities for the skilled trainees will not be a problem, at least until the labor market is saturated. This balance of educating to account for skill demand and labor saturation is a sensitive and never ending process for the educator. Employers always prefer a surplus labor market to keep costs down, while labor prefers a skill shortage to keep labor costs high. To offset these problems, successful institutional and industrial employers many times include in-service training opportunities as part of their normal operation. These training opportunities can be training sessions of a few hours to many days in length and are considered an investment in production capability. In many cases, such as hotel operation, such training may be required of experienced recruits because the hotel management has developed a particular style of service which caters to that individual clientele who routinely frequents their establishments. Even professional institutions, such as banks, have developed unique procedures in an effort to offer their customers a "customized" service. For these reasons, specialty training skills are most often satisfied through in-service short-term training sessions and or training conferences. In this manner, the employee's available skills are improved with a minimum amount of labor shortage to the employer. Potentially, the employee is pleased to have increased their marketable skills and the employer is also happy because there is an increase in the desired output, either in production or in quality.

The above discussion provides the supporting rationale for the use of short-term in-service specialized training to be conducted as skill demands warrant them. With regard to the training needs of the MMR, existing and planned donor projects have the potential to train numerous fishery staff. This report has outlined the immediate need for technical assistance in several coastal and marine resources areas. To successfully address the training needs in these areas, special skills will be required of the supporting MMR staff. Short-term in-service training is an important component of the successful outcome of these projects because the participating MMR staff will be able to practice their acquired skills while performing a necessary task.

It would appear that the longer term vocational and trade skills required for the development of the coastal and marine resources, along with other sectors of the economy, can best be met by the existing advanced training institutions such as Asmara University and the Technical Schools of Asmara and Nakfa which are sensitive to the national labor demands. It is highly recommended that donor assistance to these schools is actively pursued in order that these training institutions can expand their training capabilities. Additionally, there is an important need to conduct technical training in the Massawa and Assab areas, possibly through a branch

campus system. In addition to the formal education system of the country, the government could adopt a policy that would require all foreign investors to include in-service training as a part of their operations. It should be noted that, in addition to internal national development, an important criteria which will be considered by potential foreign investment corporations is the availability of a ready and skilled labor market.

Accordingly, the coastal and marine resources development projects recommended in this report are structured around the concept that technical assistance and training should be intimately linked. The skills that are required by the MMR may be acquired by Eritrean trainees in training programs, workshops, and classes that are provided as an element within the international donor assisted projects.

7.5.3 The role of women

While Eritrea was a very traditional society where the role of women was rather circumscribed, the long war certainly had a significant impact on the role of women. For example, it has been estimated that up to one-third of the fighters were women. Several Ministers and Department Heads in the new Government of Eritrea are women. It is difficult for a brief visitor to the country to assess what the current role of women is or what the impact of the war-time conditions will have on the future role of women in Eritrean society. However, there are outward indications that many Eritrean women are no longer limited to private lives.

In the fishery it is well known that many of the traditional shore fishers, including beach seiners and a variety of so-called "foot-fishers" were women. The FAO/TCP Project estimated that currently 36-47 percent of the foot-fishing work force was women or children. Women made up 263 of 709 full-time foot-fishers in the FAO/TCP survey. The project then made a "global" estimate, which suggested that approximately 15 percent of the total Eritrean marine fisheries work force is now comprised of women. When children are added, the report suggests that over one-third of the entire fisher population is currently comprised of women and children (Reynolds 1993a).

If an information and data collection system on the Eritrean fisheries is to produce reliable results, it must address these particular segments of the fisher population. Data must be collected not only on the sea-going fishing effort but also on the foot-fishing activities. In this effort it will be important to incorporate women enumerators and data collectors among the staff. It will also be important to incorporate specific training programs for women in the shore fishery information and data collection system.

The coastal and marine resource management components of the proposed project also identifies another area of potential expansion of women into the Eritrean work force. The tourism sector has been targeted as a major area of development and women have already begun to play an important role in the existing facilities. Although this role may presently be in the service sector, it has been observed to have already expanded into the mid-management role for visitor support services such as travel agencies and hotels. It is not unrealistic to presume that this expansion will not rapidly continue into the management sector and beyond as it has in most other countries. With regard to the project's training components and workshops, it is important that women participate because they will play an important role in the future community-based tourism sector.

Although women do not now play a visible role in Eritrea's coastal and marine planning sectors, this will be an area of encouragement for the coastal and marine management component. At present there are few trained planners in any segment of the government and those that occupy these positions are frustrated engineers and architects. In the developed world, this has recently become an area open to women because, not only is it a relatively newly accepted field of specialization, but the traditional engineering profession is more comfortable designing and constructing buildings rather than dealing with the community planning need activities which are so important to harmonious development. It is quite possible for motivated Eritrean women can be encouraged to pursue these studies, both locally at the University of Asmara and abroad.

It is important to include Eritrean women and technical assistants in the coastal management and marine area planning components of the project. This is part of an effort to build the capabilities of the Ministry of Marine Resources in working with the local communities. A significant part of the fishing population are women. They also play an integral role in family, teaching, and instilling any sense of environmental ethic in children. Decisions about the management of the communities activities should definitely be made in consultation with the local women.

It is essential to include women in the educational and interpretive training and programs for the marine area planning component. Any education program is most effective if it can be brought into the context of the family and inner community interaction. In traditional communities of the island and coastal area, women are dominant in this part of the community setting. Having trained female staff in coastal management and marine planning will be important for communicating with these local women.

An area that could be pursued as a women-specific project is a monitoring project within the marine area planning component. There are currently areas set aside for women, children, elderly, and handicapped to gather shellfish. These discrete areas

are very suitable for conducting some scientific monitoring programs. Research conducted in these traditional fishery management areas could be specifically designed and implemented by women. For example, the research could focus on testing the local belief that the operculum grows back on the shellfish after it has been harvested for "snail nails." Another potential project in the women's fishing reserve is testing different methods of collecting shellfish or sea cucumbers and looking at the effects of the different methods on reproductive rates of the animals.

Other women-specific projects include testing different techniques of preparing and processing sea cucumbers and dried fish for local consumption and export. Putting together a recipe book of traditional seafood dishes could also be done.

There is not one single aspect of the proposed project where women could not be equal participants. Women and men will be recruited and trained to be part of the national fisheries information system and take equal part in the training workshops. These will be for data collection, data entry in computers, and programming to analyze data and interpret it. Certainly the National Union of Eritrean Women should be made aware of the proposed project and the views of its membership solicited. Even for women in more traditional roles, room should be made for them to participate. Professional women who are trained and involved with the management, research and education programs will be encouraged to include the local women who live in more traditional millages.

As part of the effort to include Eritrean women in the training programs, the outside specialist should also include women. Having professional female coastal planners, marine resource managers, and fisheries specialist will be an important component of the assistance project.

However, aside from the equal opportunities for women and men in participating in the fisheries stock assessment and management program and the coastal and marine resources management programs, certain activities will need to be targeted to women specifically--both in making sure that women are actually included in all levels of activity, but also in ensuring that the project is culturally and gender sensitive. As noted above, the large role of women in the fishery necessarily means that women must be employed in the stock assessment and management activities both as enumerators and as participants in targeted projects for fishers, if the results are to be reliable. And women must be included in the coastal and marine resources management components if these resource management efforts are to be effective. In each of the components of the recommended project, several training workshops should be specifically targeted to women participants.

7.6 Technical issues

This section is divided into four sub-sections. The first deals with fishery resource management issues; the second section deals with some economic issues; the third section discusses technical issues regarding coastal resources management; and the fourth section deals with marine resources management issues. Each section deals with a variety of technical issues in more detail than in other sections of this report. Each provides some insights into the role of the recommended project in promoting the sustainability of Eritrea's coastal and marine resources.

7.6.1 Fishery resource management issues

It was clear throughout the RDA Team's visit in Eritrea that there exists a high degree of awareness for environmental conservation and of responsible management of the nation's resources. Throughout the 30 year struggle, people saw their countryside destroyed while, by an large, the marine environment was relatively spared. Indeed, the priority list of the MMR includes conservation of marine resources and the establishment of a marine park (e.g., conservation area), along with extraction of marine resources. The proposed project is therefore based on a shared vision of sustainability as a management objective.

Managing marine and coastal resources sustainably means being able to harvest the surplus produced by this complex ecosystem and to enjoy and share its beauty *in perpetuity*. It may be useful to think of fisheries resources as a form of natural capital out of which flows a stream of income. To manage sustainably is to ensure inter-generational equity, i.e. the capital stock is saved for future generations and that only the interest stream is consumed by current generation. In this section we discuss the technical aspects of the proposed project that have a bearing on sustainability as a management objective.

The concept of Maximum Sustainable Yield (MSY) was put forward by biologists to challenge the notion that the oceans have an inexhaustible source of fish. It proved to be a useful principle, but there are several objections to its application as it is strictly biological. Fishing is an economic activity and the quantity that needs to be maximized is not necessarily the harvested biomass, but rather, it is the economic benefits, or, more accurately, the economic rent which should be maximized. Economic rent is the surplus left when total aggregate costs of fishing are subtracted from the value of the catch. Hence, Maximum Economic Yield or Maximum Social Yield concepts have also been developed. For this report's analytical purposes, however, the concept of MSY will receive the focus. The models used to calculate MSY are static in that the models treat the two important parameters of stock productivity (r) and the carrying capacity of the environment (K) as if they are unchanging from year to year. One can think of stock productivity as a measure of

how hard the stock can harvested, or alternatively, how high a harvest rate can it support on a sustainable basis. The parameter K, the carrying capacity, on the other hand, is a measure of stock size. It is possible to have a large stock that is not very productive; or a small stock that is very productive. A third parameter of catchability (q) is a measure of vulnerability to gear. We know that all of these parameters are dynamic and can only be approximated. To use the metaphor of natural capital, we can say that the size of the capital stock (i.e., the fish population) sitting in nature's bank account is neither constant in nature nor accurately known. Similarly, the interest rate on the fishery capital is also not a constant. The challenge of stock assessment is to produce an estimate of what can be caught sustainably. The challenge of fisheries management is to ensure that this mandate is carried out. This is not an easy task. The world is full of examples of collapsed fisheries stocks and ruined coastal ecosystems.

The MMR recognizes that there are many threats to sustainable management of fisheries resources. Three major threats to the sustainability of these resources will be discussed in the interest of mitigating them. These three threats are 1) the common property nature of fisheries resources coupled with the open access to them, 2) the rate used to discount future benefits, and 3) the fact that we live in an uncertain world (DMRIF 1993b).

The principal threat to sustainable management of fishery resources is often summed up in the phrase "the tragedy of the commons." The tragedy arises because no one is prevented from access to and use of the resource. Unlike privately owned property where access to the property is limited to the owner, common property is property to which all have open access. With common property, where ownership is undefined, no one has an incentive to husband the resource. Indeed every user has the opposite incentive, namely, to take what is there before someone else does. Entry into the fishery will continue as long as the costs of the last entrant are covered. The net effect is that the aggregate cost of harvesting the catch is equal to the total revenue, and the fishery is said to be at a bio-economic equilibrium where economic rents are dissipated. This is the tragedy of the common property resource where everybody loses.

While Eritrea's fisheries resources may have been under-exploited during the last fifteen years, they are not inexhaustible. The common property problem may be avoided by addressing it early on and by assigning property rights to users who thus have the legal right to exclude from the fishery those who do not have such rights. Territorial use rights in fishing (TURF's) and licensing are part of the legal framework envisioned by FAO.

In the stock assessment and management component of the recommended project, the efforts will seek to mitigate and prevent such a tragedy by advising the

government to establish a set of regulations and controls on the fishery, such as limiting output and setting an annual Total Allowable Catch (TAC) and monitoring the performance of the fishery through the information system.

Discounting of future benefits is another mechanism that undermines sustainable management of fisheries resources. Discounting is a measure of preference of a present benefit when compared to a future benefit. If a fisher is indifferent to the choice between receiving a 100 Birr now and receiving 110 Birr a year from now, then his or her discount rate 10%. On the other hand, a fisherman, who is in immediate need of money to buy necessities to carry on his livelihood, may be prepared to accept 50 Birr now rather than 100 Birr a year from now simply because he does not have the luxury of waiting until next year. Sheer financial desperation on the part of fishermen, coupled with open access can drive a fishery to its nonprofitable bio-economic equilibrium.

The same analogy can be applied to the country as a whole. If immediate benefits are valued more than future ones, then a boom scenario exists where trawlers can come in Eritrean waters, catch a lot of fish, generate some short-term employment and foreign exchange and then leave. If, on the other hand, policy makers desire to maximize the sustainable benefits over the future, then a policy of gradual expansion of the traditional fleet would be the more appropriate one.

The MMR also recognizes the threat of uncertainty to the sustainable management of fisheries resources. Even with the best data and models in hand, predictions of future catches are based on parameter estimates that are, at best, uncertain. Annual and long term variability of oceanographic and atmospheric conditions do affect the coastal marine ecosystems and can have profound effects on fisheries. Again, the world is full of examples where heavy and irreversible investment in fisheries was based on optimistic projections. It is not uncommon for governments to discover the cost of such optimistic projections. Poor decisions can be socially very costly in the future. The proposed project will seek to develop expertise in the MMR to set reasonable and cautious TAC's and the ability to track the performance of the fishery through the fisheries data collection and analysis system. Stock assessment is not a static one-time exercise in prospecting, but a constant learning process. Through the periodic workshops, the project will aim to incorporate uncertainty into the decision making framework of managing the fisheries resources. At the same time, the project will promote an environment of cooperative research and management where fisheries workers in the MMR cooperate with the fishers to manage the fish stocks. Cooperative and experimental management, in contradistinction to classical imposed management, has a much better chance of being accepted and, therefore, self-enforced by fishers themselves. This is congruent with the proposal put forward by the UNDP-GEF project, namely to have Community Based Management. A marine resources management area zone called a non-fishing marine reserve, which is set

aside where no fishing is allowed, can serve conservation purposes as well as purposes of experimental designs, namely, to have control areas against which the effect of fishing could be compared after a few years. The other two elements of experimental management are replication and contrast. Groups of similar fishing areas could be identified with the help of fishers where methods of fishing, targeting, and gear could be tested, replicated, and compared. When these elements are explained to fishermen without obfuscation, they could be valuable partners in the management endeavor.

With uncertainty comes risk taking. The proposed project will seek, through the fisheries information system component, to build the ability to identify those elements which make up the possible environmental and economic outcomes of alternative management decisions.

A fishery may be thought to have four elements, each with its own internal forces, but interacting with the other elements in a manner shown in Figure 7-1 on page 7-50. At the base are the fish stocks upon which all the sector depends. Various production models are employed in the discipline of population dynamics to try to estimate the long term harvestable surplus. This is an area for fisheries science, and it takes years of training to develop a working skill in this area. The proposed project will not address training in fisheries science, as this is the realm of graduate level of studies in a university. What the project will do is provide experts with this kind of specialized training who are also capable of conveying the material in a practical manner that is oriented towards training a cadre of practitioners of fisheries science who can use the proper tools to generate basic information. This will be accomplished by the long-term resident Fisheries Stock Assessment and Management Specialist and during the periodic workshops throughout the project (see section 7.4 for further details). The priority will be to set up a fisheries information system that will generate the basic data, regularly and reliably. This will start from training enumerators in data collection and a cadre of employees in data entry, processing, and manipulation.

To produce good resource management advice, the project will dedicate part of its effort to the collection of information on the fishing fleet itself. The information desired will not only be on the size and characteristics of the fishing fleet, but also the fleet's spatial and temporal dynamics. One can think of a boat and the assortment of gear as the fish predator that could be studied using some of the same concepts developed in ecology on predator/prey relationships. Details of the fleet, its size, investment, and its behavior, spatially and seasonally, can reveal much for management options.

Fishing boats, individually and as a fleet, deliver their catch to the processing sector and, so, are functioning in an economic environment. It is here that the

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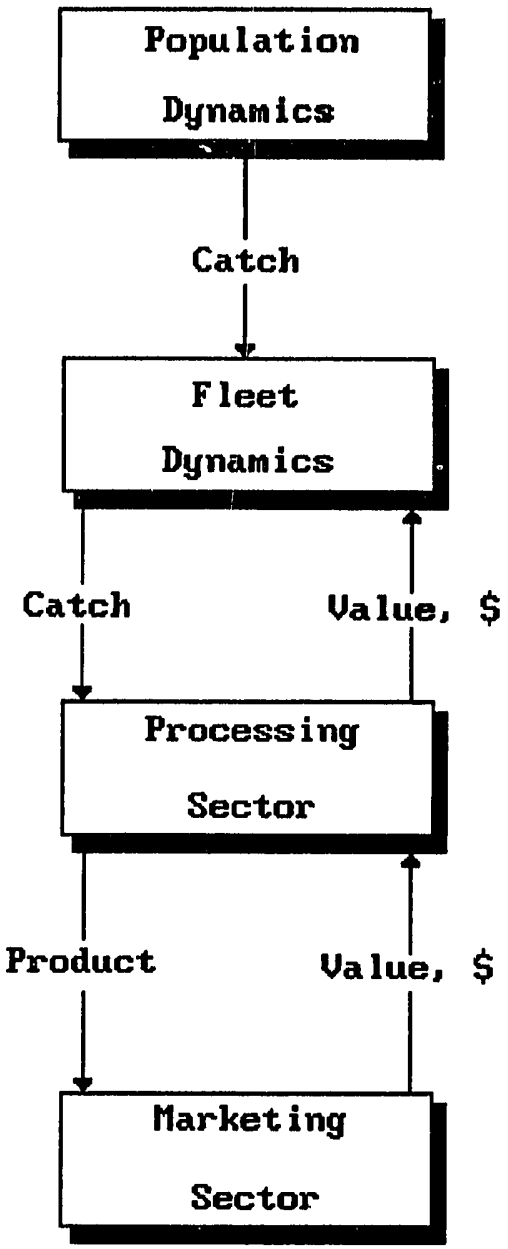
macroeconomic policies of the government can affect the fisheries sector. The proposed project will collect and analyze data about the processing sector periodically. Currently, the marketing sector is not distinguishable from the processing sector. Only one private company exists that processes fish products for the local market to any degree.

Figure 7-1 The four major elements of a fishery and their interaction



In summary, the proposed project will establish the ability to collect and analyze information on all four elements of the fisheries sector discussed above. The outcome of the proposed project, namely, the sound assessment and management of the fisheries resources in Eritrea, will have a solid start.

7.6.2 Economic issues

Several economic issues will be addressed in this section, namely, the market environment and the relation between the public and private sector, public price controls and price policy, the fishery export potential, and the economic value of the Eritrea's fishery resources. The political/economic environment in which the fishery operates is intimately related to the fishery resource management regime and how successful sustainable fishery resource management will be. The relationship between the fishery management regime and the political/economic policy environment will be addressed in each of the following subsections.

7.6.2.1 The public and private market roles in the sector

The fishery sector, just as all the sectors of the Eritrean economy, was devastated by the thirty years of war. The government has stepped in to help rehabilitate the fisheries sector as it has in other sectors. Fisheries is no exception is this regard. The fisheries sector is considered such a basic industry that government has taken charge of reorganizing it. The Government owns and operates the only ice making and cold storage facilities in Massawa, and it has organized the buying, selling, transport, marketing, and distribution of fish and fish products in Massawa, Assab, and Asmara. While there is some informal buying and selling of fish and fish products in the market, the Government has had to take the initiative in getting fish production and distribution operating again. The Government is taking the initiative in getting the fishers to reorganize themselves in democratically-run cooperatives. All of the major hotels and other institutional purchasers of fish are also operated by the Government. The fisher cooperatives also work closely in tandem with the MMR and the Government in helping rehabilitate the fish market. The Government sets the prices which are paid to fishers for fish at the landing sites in Massawa and in Assab, and it sets the prices paid by the final consumer.

While the government is playing a big role in the marketing and distribution of fish, the fishers are still private operators. As has been noted above, the physical capital, the boats and gear, of the fishers has been degraded as has the physical capital throughout the economy. However, the fishery sector is exceptional in that the fishery resources themselves were not destroyed by the war or the recent drought which have had such a drastic impact on other resource bases. In fact, as has been noted several times in this report, it is likely that the fishery stocks are more abundant now than they were 25 years ago. Thus, the rehabilitation of the fishing sector may

proceed rather quickly once cold storage and transportation facilities are reconstructed and marketing channels reestablished. The potentially rapid rehabilitation of the fishery sector is one of the main reasons that it is important for Eritrea to focus immediate attention to establishing a fishery stock assessment and management system which can guide the growing fishing effort in a sustainable direction.

7.6.2.2 Fish price controls and price policy

As noted above, the government is currently setting the prices on fish. The current price paid to fishermen for Grade I fish (snappers and groupers) is Birr 4.00 and the price paid the consumer is Birr 5.00, leaving a small margin of only Birr 1.00 for cooling, storage, the wholesaler, and retailer. The fish prices have been raised several times during the past year, principally because it became clear that the fishers were not making a sufficient return to justify the effort. As recently as July 1992, the producer price of Grade I fish was set at Birr 2.00 and the consumer price was Birr 2.50 in Massawa and 3.00 in Asmara.

Until October 1992, the DMRIF (now the MMR) was the only institution transporting fish to Asmara, where it was sold through the Merat Bahri Cooperative (or the Dahlak Island Fishermen's Association and Distribution Cooperative) market, which has eight fish retailers in Asmara. Beginning in October 1992, the Red Sea Cooperative (or the Red Sea Fishermen's Association and Distribution Cooperative) began operating its own outlet in Asmara. The Red Sea Cooperative has its own members from which it purchases fish, but it also purchases fish from non-members. The Cooperative rents some of the government's cold storage facilities at the Massawa landing site, but owns its own delivery truck and operates its own retail outlet in Asmara. While the government supply to the market in Asmara is irregular, the Red Sea Fisheries Cooperative apparently makes fish available on a regular daily basis, although it operates on the same margins and under the same circumstances as the government operation.

The current government price controls and price policies are justified by the arguments that the prices of fish must be kept low enough to make it accessible to poorer consumers who cannot afford meat (Reynolds et al. 1993a) and low enough to encourage fish consumption among consumers who have not traditionally used fish in their diets.

The ill effects of fixed price controls are well known. Prices, particularly for perishable products and those in irregular supply, need to be flexible enough to adjust to fluctuations in supply (i.e., availability or fish landings) and demand (i.e., fish consumption levels at various prices). Price controls to "protect" consumers usually are set so low that they discourage production. It is clear that only a few months ago, prices of fish were too low to provide an adequate margin to the fishers, and the

fixed prices have been adjusted upwards several times. It is difficult to determine what the free market price for fish would be, particularly in view of its irregular availability. The MMR now has some staff members trying to determine the costs of producing and marketing fish, but the whole effort is being conducted by staff members with little or no training in business or economics. Thus, the MMR is in a difficult policy situation, trying to set prices with limited information on or understanding of the production or market conditions.

The FAO/TCP Project proposed national fisheries strategy included a recommendation to "move towards a system of liberalized controls on prices, aiming to achieve early deregulation and the operation of free auction buying at landing sites in order to provide producers with appropriate incentives and counter unattractive cost-earning balances in small unit operations (Reynolds 1993b)." While this is certainly a sound recommendation, it is doubtful that the government will be able to move to a fully free market auction system soon. However, there are interim steps that could be taken immediately to make the pricing system more responsive to actual supply and demand conditions.

The catch rates by the artisanal fishers are now generally high because the fishery has been under-exploited for many years. The fishery has greater numbers of fish and larger sizes of fish than will be the case when the exploitation rate eventually approaches its maximum sustainable yields. However, there are still the relatively good winter fishing season and the relatively bad summer fishing season, just as there are relatively good catches some weeks and relatively bad catches in other weeks, regardless of the season. The fixed producer prices for fish appear to be discouraging fishing effort during the off season but provide relatively high returns during the winter season. Some flexibility could be introduced into the fish pricing system, even before the Government is willing to let the market go free. For example, a partial freeing of prices could be introduced by allowing the producer prices to vary within a range of 10 percent over the month, depending on the availability of supply relative to the cold storage capacity and the amounts of fish the retailers can handle. A new monthly price could then be set according to the previous month's average price of fish. This would give those with the responsibility for setting the fish prices some experience in reading the market signals. At the same time that such an approach allows a margin of flexibility in fish prices, it would tend to increase the regularity of fish supply and allow the price mechanism some small role to play in adjusting fishing effort and catch to the seasonality of the fish catch, to the growth in the available cold storage and transportation capacity, and to the changes in demand, e.g., responding to such things as the large number of Orthodox Christian "fasting days." Modest experiments in allowing prices to adjust to variations in supply and demand would provide a learning environment for the price setting officials. Such suggestions as this should not be interpreted as discouraging the move to free market prices--a move which should be made as soon as possible--but instead it should be seen as a

mechanism for providing more market information to the decision makers and as a way to alleviate some of the constraints of the current fixed price system on the expansion of the fishing industry.

The Government could also explore other means of accomplishing its policy objectives than using price controls. For example, there are better methods of encouraging fish consumption among people who have not traditionally eaten fish in their diets than by setting a low price on fish. The Government could expand its effort to provide nutritional information with fish cooking demonstrations. Or it could provide an overt subsidy to offering fish sandwiches to school children occasionally or even once a week, depending on the scale of the effort. If the objective is to provide inexpensive meat to the poorer consumers, methods can be found that do not carry the adverse effects of price controls. For example, while paying the going market price for fish, the government could supply fish at openly subsidized fish prices to the poorer consumers on certain days of the week at designated market outlets.

One of the least attractive aspects of the Government setting the prices on fish is that as the gap widens between the fixed price and the free market price, there is increasing incentives for middlemen to "cheat" on the system. As soon as some customers are willing to pay a substantially higher price than the fixed price to assure a steady supply of high quality fish, side-deals and black markets will develop. While the fish market is still a very small one, when such activities happen on a large scale, a certain level of corruption is introduced into the system, with untoward consequences for political and social development of the whole society. It is wise for policy makers to understand that government price setting carries with it some potential for unsavory dealings.

Lastly, the current price control system appears to be more focused on the consumer-producer relationship instead of on the intersectoral relationships (e.g., the relation between the fishing sector and the agricultural sector). Yet, it is the intersectoral discontinuities that arise from price controls that often give rise to the most serious problems.

Currently, the government has focused its attention on the marketing and distribution of fish, leaving the production to the fishers themselves. However, there is a good case to be made that the allocation of government staff effort needs to be realigned with the unique situation in the fisheries sector. Marketing and distribution tend to take care of themselves. In fact, these tend to be quite competitive sectors which are difficult for governments to control effectively or efficiently. Where government efforts can be effectively directed, however, is to managing the resources, i.e., setting the rules and regulations which govern how the resources are exploited by fishers. Given the limited resources available to the MMR, a reallocation of efforts from market

control to resource management is likely to have a high payoff in terms of promoting the sustainability of Eritrea's coastal and marine resources.

7.6.2.3 The value of Eritrea's fisheries resources

The value of Eritrea's fisheries resources are substantial. However, the potential value far exceeds the actual value of Eritrea's fisheries in their currently under exploited state. Even when more fully harvested than they are today, the potential value of Eritrea's fisheries are likely to exceed the actual value for many years, particularly in view of the technological and marketing requirements for marketing its exportable fish and fish products in foreign markets. Nonetheless, it is of some importance to gain at least a general understanding of the value of these fisheries resources in order to put into proper perspective the importance both of developing the exploitation of these resources and of exploiting them sustainably.

It is important to immediately put into perspective the value of Eritrea's coastal pelagics, its largest single exploitable stock of fisheries resources. These coastal pelagics, principally small sardines and anchovies, were once the basis of a rather large export industry. As noted in Table 3-1 on page 3-5 above, Eritrea produced about 25,000 mt of pelagics, largely the small coastal pelagics, in 1954-55, and from 6.7 mt to 19.7 mt of pelagics each year during the decade between 1962-63 and 1971-72. As reported above, in the early 1960s, there were six fishmeal plants operating in Massawa, using the output of 2-3,000 fishermen during the winter season. There was an active market in fishmeal at that time. However, today, soybeans and other products have completely devastated the fishmeal market, and these same small coastal pelagics are now almost valueless on the world market. While the maximum sustainable yields of these coastal pelagics have been estimated at 25-50,000 mt annually, or from one-half to two-thirds of Eritrea's total maximum sustainable yields from all fishery resources (see Table 3-3 on page 3-7), Eritrea faces a serious problem in finding a profitable way of using these resources. They may be able to be used locally as dried or canned fish, as fish meal, or as dried fish for silage. However, none of these alternatives is likely to be particularly profitable. The harvesting and processing are necessarily seasonal, being harvested as they are for only about half of the year. Furthermore, because of the oil content and the typical strong taste, Eritrea faces a challenge in making these fish acceptable as human food. There are similar problems when they are used for animal feed. In addition, the fishery resources are located far from local markets, thus requiring substantial transportation costs. Despite these problems and limitations, however, Eritrea will probably want to pursue the exploitation, processing, and domestic use of these coastal pelagic resources. Having little or no value internationally, however, the local value does not need to be very great to justify their exploitation. Harvested and processed as an import-substitute, either for human or animal use, Eritrea may be able to find a use for these resources which contribute to domestic food requirements at

values which exceed the relatively low opportunity costs, of labor and other inputs, of the exploitation. Nonetheless, for the immediate purposes of valuing Eritrea's fisheries resources, and especially until some acceptable domestic alternative use is found, these coastal pelagics must be accepted as having marginal value.

Eritrea has modest stocks of tuna and shark, perhaps together reaching a maximum sustainable yield of 5-10,000 mt annually. The most valued food fish, however, are the demersal fish, principally of the snapper and grouper families, which have maximum sustainable yields estimated at 8.5-18,000 mt annually. Since other fishery resources are minor, it will be useful to focus on the roughly 20,000 mt sustainable yields of food fish. (See Table 3-3 on page 3-7.) Once more is known about Eritrea's Red Sea fishery, estimates of these resources may be able to be known with more exactness. For the purposes of this report, however, using the estimate of the maximum sustainable yield of 20,000 mt would be an acceptable general estimate.

During September 1993, first quality (Grade I) food fish were being sold in Massawa by fishermen at less than US$0.80 per kg and in Asmara to consumers at less than US$1.00 per kg. In view of the dramatic fluctuations in the foreign exchange rates, it is not necessary to be more exact than this. Even if all of the sustainable yield of food fish were of high quality, which is certainly is not, the final domestic consumer value of the sustainable yield of 20,000 mt would be on the order of US$20 million annually. Since the controls on fish prices are currently artificially low, once fish prices in general, and the full range of fish prices associated with various qualities of fish, are allowed to adjust to market conditions, this estimate of the domestic value of Eritrea's food fish of US$20 million annually will be in the right range.

Currently, only 5-10 percent of this sustainable produce is being harvested and reaching major markets, and even the highest estimates suggest that only about 20-25 percent of Eritrea's sustainable yields are currently being exploited. Thus, the domestic value of Eritrea's fishery will increase by 5 to 20 times during the coming years as the fishery becomes more fully exploited.

This estimate of the domestic value of Eritrea's fishery resources is certainly a minimum estimate. Eritrea has numerous fish export options which offer much more profitable prospects. Once the ice-making, cold storage, and refrigerated truck capacity increases, not only will the domestic market expand but also the export market will expand. Addis Ababa is a natural, easily accessible, export market for Eritrean fish. Markets which once existed can be reestablished and expanded. Despite the fact that such exports would earn Ethiopian Birr rather than hard currencies, however, this market will substantially increase the final value of Eritrea's fishery. Substantial, but unknown, amounts of fish are currently going to Yemen, as many Eritrean fishermen freely operate in both Eritrean and Yemeni markets. However, the fact that such informal trade already exists, there is certainly an

opportunity to substantially increase the value of Eritrea's fishery by exporting to Yemen and other regional markets. Recently, six Egyptian trawlers were detained in Eritrean waters. Clearly, the opportunity for Eritrean fishermen to export fish to Egyptian markets via a fish carrier boat exists. The same fish that sells in Asmara for US$1.00 per kg may sell in Cairo markets for upwards of US$6.00-7.00 per kg. There are several options open to Eritrea to export high quality food fish to regional markets to earn foreign currency while increasing the market value of its fishery products. While it would be difficult to get a group of experts to agree on the details of Eritrea's fish export prospects, it is easy to see that modest efforts to export several thousand tonnes of food fish to regional markets each year could more than double the estimated value of Eritrea's fishery resources.

Such prospects should not be exaggerated, however. Several individuals have variously estimated the export value of Eritrea's fishery exports at US$20-40 million annually. It is true that Eritrea's high quality demersals could in principle be exported via air to European markets and reap a value of US$5-6 per kg or even higher. However, to earn revenues approaching these levels, Eritrea would have to vastly expand and improve its ice-making, fish handling, packing, and marketing capability. And to earn such large revenues, Eritrea would have to export from a quarter to half of its highest quality fish catch. Certainly, expanding targeted high quality fish exports to European markets is a desirable goal, but such exports are likely to remain small in the near future. Eritrea can prepare for such a future expansion by focusing on improving local fish handling, cold storage, transportation, and marketing first. As the capacity for quality fish marketing improves, regional markets can be targeted, and, finally, some of the higher valued European fish markets may be entered. In the meantime, and as a first step, it is important for Eritrea to expand local fish production, marketing, and consumption. In this way, Eritrea may be able in the near future to reap for domestic purposes the baseline fishery value of some US$20,000,000 annually, and at the same time contribute to the food and nutrition requirements of the Eritrean population.

7.6.3 Coastal resources management issues

The coastal zone is a complex interconnected ecosystem with movement and exchange between land and sea through wind, water, nutrients, sediment, flora, and fauna. Food webs for many coastal stocks of finfish depend on nutrients produced in coastal environments such as mangroves, coral reefs, and seagrass beds. Rivers draining into the sea bring nutrients to feed the nearshore system. In a natural system, the land has numerous influences on the sea. The sea also affects the land through coastal erosion, wind and storms, weather, and evaporation of water for rain.

When humans use and interact with these coastal ecosystems, the effects can be felt in various parts of the ecosystem, and may have short or long term impacts.

Therefore, the management of these uses and activities must recognize these linkages and develop policies, plans, and programs that are multi-disciplinary and multi-sectoral. People, government agencies, and industries that represent these different sectors that are not accustomed to working together, must develop mechanisms for interagency and inter-sectoral coordination to address these issues. Coastal resources management is recognized throughout the developed and developing world as an essential component in urban and regional planning as well as marine resources planning. Coastal planners provide the link between urban planners and marine resource managers, and between policy makers and scientists.

A coastal planner beginning to develop a coastal resources management plan in a given region approaches the task with a certain methodology. There are three basic steps: assessment of the coastal resources in terms of type, location, quantity and quality; assessment of current and potential human uses of these coastal resources; identification of areas where an existing or a proposed activity or use is or will be incompatible with an activity or use of an adjacent resource; resolution of existing conflicts, and decision-making regarding future uses and activities to minimize the conflicts through management plans, development guidelines, and environmental quality monitoring programs.

In the resources assessment phase, these resources can be roughly divided into four categories: those of direct economic benefit to humans, those of indirect economic benefit, those affecting our quality of life, and those of benefit to the non-human environment. The different resources within these categories include:

Table 7-2 Categories of coastal resources for management purposes

Direct economic benefit	Indirect economic benefit	Benefit to quality of life	Environmental benefit
fisheries, mangroves, coastal forests, fresh water, arable land, minerals, oil,	seagrass, coral reefs, beaches, coastal waters, embayments	clean air, clean water, clean beaches and other coastal areas, open space, open viewplanes	areas of environmental sensitivity, areas of high biodiversity, habitat of rare and endangered species, productive habitat for other species that are not of direct economic benefit, such as remote mangrove, seagrass, coral reef, deep ocean areas.

The next step is to assess current and potential human uses of these coastal resources. These uses include urban, industrial, agriculture, silviculture, aquaculture, fisheries, mining, oil exploitation, ports and harbors, shipping, recreation (boating,

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swimming, fishing, surfing, windsurfing, snorkeling, scuba diving), tourism, waste disposal.

Once the current and potential uses of the coastal resources is assessed, the next step is to identify areas where an existing or a proposed activity or use is or will be incompatible with an activity or use of an adjacent resource. A few examples would serve to illustrate this. A sand mining operation adjacent to a tourism or residential beach would be incompatible since the depletion of sand from the long-shore transport cell would cause erosion of the adjacent beach of high economic value. A sewage outfall in an embayment that is also used for bathing or collection of mussels, clams or oysters would be incompatible due to the bacterial contamination increasing the risk of public health problems. Discharge of industrial pollutants including toxic chemicals or heavy metals into waters used for fishing, bathing is incompatible due to the potential public health problems. Conversion of a mangrove area through cutting, filling or dredging adjacent to coastal waters fished for finfish or shrimp would be incompatible since the fish or shrimp stocks would be significantly reduced by the loss of food and nursery habitat. Fishing in a coral reef area that is a prime scuba diving site for tourists and local divers is incompatible since it reduces the quality of the dive experience and would result in fewer visits and less income to the local tourist industry.

Where current conflicts exist or potential conflicts may result from proposed development projects or activities, a resolution can be achieved through the process of developing management plans, development guidelines and environmental quality monitoring programs. Human uses of the coastal resources can be sustainable for many generations if careful planning is implemented before major land and water uses take place or get established. Once the assessment of coastal resources and human uses, and the identification of areas of conflict have been accomplished, the challenge is to resolve existing conflicts, and make decisions regarding future uses and activities to minimize the conflicts.

A fundamental requirement for developing coastal resources management plans in a country is the inclusion of basic policies of integrated coastal zone management and sustainable development in laws relating to land use and marine resource use. These laws are promulgated at the national, provincial, and municipal level. Generally a national coastal zone management law sets the basic principles, goals and objectives. Provincial laws and municipal laws usually model their own coastal zone management laws after the federal law, and also include specific provisions that are necessary to address unique local issues.

The next requirement is an institutional framework for developing the coastal resources management plan. Usually, there is a coastal zone management program at the national level. This is sometimes found in the Department or Ministry of

Environment, Natural Resources, Interior, or Planning and Economic Development. In the case of Eritrea, the fact that management of marine resources is accorded a ministerial level administrative unit with a coastal zone management program within it indicates the high level of importance placed on marine resources within the government. This strengthens the capability of the coastal zone management program to coordinate the various ministries and sectors to achieve integrated coastal resources management.

A coastal resources management plan is an inter-sectoral plan that draws on the development plans for industries, urban areas, agriculture, forestry, aquaculture, tourism, mining, oil and gas exploitation, water resources, energy production, land transportation, ports and maritime transportation, parks and recreation, and fisheries. It combines the goals and objectives of these development plans, with the resource assessments, and analysis of potential or existing conflicts of use, and recommends segregation of incompatible uses, cost/benefit analysis of conflicting uses that rely on the same resource or site, and guidelines for development that minimizes negative impacts and the resulting conflicts. A zonation system is used in a similar but more expanded manner than used in urban and regional planning, in which zones are assigned for industries, residential areas, public open space, recreation areas, tourism development areas, historical reserves, wildlife reserves, and mangrove or coastal forest reserves. In addition to the land-based zonation, nearshore marine areas can be zoned as well, including zones within marine resource management areas for non-fishing marine reserves, scientific research areas, aquaculture sites, fish collecting areas, artificial reefs, interpretive areas, trawling areas, oil and gas development areas, ports and harbors, marine transportation channels, and zones for different ocean recreation such as scuba diving, snorkeling, swimming, surfing, shore fishing, sailing, and windsurfing.

Development guidelines can take many forms, including construction codes and regulations, such as building height, density of development, construction setback from the shoreline. These guidelines could include conservation zoning such as setting aside open space areas, green belts, riparian buffer zones, and conservation corridors. Rehabilitation or restoration requirements can be included such as revegetation of previously mined sites, reforestation of harvested forests, and planting of dune grasses to stabilize eroding dunes and coastlines. Waste management guidelines can be developed for requirements for different types and levels of sewage treatment systems, guidelines for reuse of treated effluent, solid waste collection and disposal systems, recycling programs, and proper disposal of used oil, paints, and other hazardous substances. Requirements can be made for integrated pest management plans to reduce use of pesticides on landscaping and turf. Soil erosion prevention techniques could be required such as terracing, development of channels and settling basins, and intercropping in fields to prevent loss of topsoil. To ensure minimal impact on the coastal ecosystem, the developer of a coastal resort or housing

project is often required to conduct an environmental monitoring program to establish a baseline and provide on-going data on the quality of the coastal waters, air, wetlands, mangroves, coral reef, seagrass beds and other marine life.

In recreational boat harbors, used oil and sewage pumpout facilities are often required. In commercial harbors, especially those that have fueling facilities or petroleum transfer and storage facilities, an emergency oil spill response and clean-up plan is required with the necessary equipment and trained personnel. In the offshore oil and gas production platforms, there are specific requirements for pollution control and emergency response that are required.

Coastal resources management plans and development guidelines provide useful tools to help prevent and resolve conflicts resulting from coastal resource use and development. They require a high level of cooperation among different sectors, levels of government, with the private sector, and with the general public. Because of the significant role women play in marine and coastal resources use in Eritrea, it is important to have trained female coastal planners to be able to work and communicate with women in the community. Policies, plans, guidelines and monitoring programs are all necessary to guide coastal development. In addition, this all needs to be complemented by a strong public education campaign to raise awareness on how each individual needs to take responsibility for their own actions to help protect and sustain the coastal environment.

7.6.4 Marine resources management issues

Marine resources management areas are recognized as effective means to help achieve sustainable use of the marine resources of nearshore marine areas or offshore submerged resources. These are most effective when designed in conjunction with coastal resources management plans. In this way offshore and nearshore marine resource use is integrated with coastal uses. "Marine resources management area" is a general term describing a variety of types of marine conservation and marine management regimes. For this project, "marine park" is used only as a designation of a marine conservation area, for example, a non-fishing zone for fish recruitment and fish replenishment but which may or may not also support certain tourist diving activities. The broader marine resources management area would include a range of zones or areas from marine parks or marine preserves where no human activity is allowed to a multiple use area where even extractive activities are allowed and limited, along with a variety of nonconsumptive uses and activities. The management of the various resource uses is called marine resources management. These marine resources management areas usually cover an area of marine waters from the high reach of the high annual wave or the vegetation line on shore, out to sea to whatever boundary decided upon based on use or ecosystem characteristics. In some cases, terrestrial coastal management areas or parks are located directly adjacent to marine

resources management areas or parks to form an integrated coastal park. The regulatory spectrum for marine resources management areas is broad, so that as a management tool, it is adaptable to local conditions, goals, and objectives.

Table 7-3 Different uses potentially regulated by marine resources management areas by category

Extractive or consumptive uses	Nonextractive or nonconsumptive uses
fishing, edible shellfish collecting, ornamental fish or shellfish collecting, aquaculture, sea-ranching, mining, oil and gas exploitation, mangrove harvesting, waste disposal	swimming, boating, shipping, windsurfing, surfing, snorkeling, scuba diving, photography, wildlife viewing

These consumptive or nonconsumptive uses of the marine resources management area can all be regulated by setting limits by area, season, level of use, allowable gear, and requirements for accompaniment by a certified guide. Incompatible uses can be segregated, a permit or registration system can be instituted, and an ongoing monitoring and enforcement program continuously evaluates these uses and makes recommendations for adaptations in the zonations or rules. Some restrictions, for example, can be rotated on a yearly or multi-year basis, in order to allow use but not overuse of these sensitive areas. In this way, multiple, compatible uses of the marine environment can be managed

Enforcement is done in the manner of a park ranger, emphasizing education rather than police-style enforcement. However, if necessary, the park rangers usually have the authority to arrest and detain a person suspected of illegal activities. Rights of seizure, forfeiture, and penalties for breaking the laws or regulations are usually established. Entrance and day-use fees (such as an established fee for each day a scuba diver dives in the park) are often charged to defray the cost of managing the park.

In addition to managing human uses of the area, a marine resources management area is usually very much involved in marine resource monitoring programs to assess and continue to monitor the characteristics of the marine environment. This includes identifying the location and characteristics of the different habitats in the marine resources management area, areas of environmental sensitivity, habitat for rare and endangered plants and animals, nursery areas for finfish recruitment, areas of high biodiversity, and areas of significance because of the uniqueness of the natural environment. Marine resources management areas can play a significant role in protecting the biological diversity of the marine environment at the local and, indeed, global level.

In the establishment of a marine resources management area, along with marine parks, and the identification of the different zones for restricting the types of human uses, it is essential to have the involvement of the local community and user groups. Not only must they buy into the process in order to support the management plan and be willing to follow the rules, but they also must realize benefits from the establishment of the marine resources management area. Benefits can be accrued as improvements in quality of life, educational opportunities, or in purely economic terms. In many cases, customary subsistence activities of local villagers can continue in certain designated areas with restrictions and monitoring on the level and type of use. However, in some cases, these activities are displaced by the establishment of the marine resources management area, so their economic livelihood must be changed. This can be done by employing some of the people, such as the fishermen, for example, as guides, boat captains, or providing other services for those using the area. Small-scale accommodations owned and operated by the local villagers has also proven successful. Care must be taken, however, to minimize the social impact of the influx of visitors into areas that previously had little contact with outside people. It must be note that to involve the local women, it is essential to have women who are trained marine resources management area staff that can build those communication linkages.

Various technologies are available to facilitate management of marine resources management areas. In the initial stages of resource assessment and inventory, aerial photographs, and satellite images are invaluable to provide accurate depictions of the land and submerged resources. With experience, one can distinguish different habitats on these photographs and images, such as coral reefs, seagrass beds, mangroves, sandy, or rocky substrates.

Sometimes, accurate navigational charts are not available for an area, or the available ones are out of date or not of a large enough scale to be useful. In these cases, charts derived from these photographs and images are best. These can be generated by digitizing these images onto a computer-based mapping system, either a type of Computer Aided Design (CAD) system, or a more powerful Geographic Information System (GIS). GIS programs have advanced rapidly in recent years, and at a reasonable cost, they can provide the capabilities to make accurate charts of land formations, reefs, seagrass beds, mangroves, and any other category of habitat found. Different layers of mapped data can provide information on human uses of the adjacent land area and of the marine area itself, the zonation and regulatory system, dive sites, mooring buoys (with attached data on usage), marine environmental monitoring data points with attached data sets, sightings of dugongs, turtles, whales, dolphins and other unique creatures, shipwrecks. The GIS is a versatile planning tool that interfaces well with marine scientific research and coastal resources management efforts.

As a complement to the GIS and remote sensing data, the advent of affordable Global Positioning System (GPS) units has proven to be useful in adding even greater accuracy to research and monitoring efforts. These GPS units utilize a series of navigational satellites to pinpoint the location of the user, providing accurate latitude and longitude coordinates.

In addition to these technologies, research, monitoring and enforcement programs of marine resources management areas rely on boats, engines, hand held and boat radios, binoculars, scuba gear. Aircraft are extremely useful also, but can be a significant drain on a park's budget, so they must be used sparingly. Besides the park rangers and monitoring scientists, in many marine resources management areas, users play a role in monitoring the environment. Users are requested to fill out survey forms indicating the places they visited, plants and animals they saw. This is especially true in the case of rare and endangered animals, such as the dugong, sea turtles, or cetaceans such as dolphins and whales.

Multiple use management through marine resource management areas provide a flexible management tool that can be crafted to meet the needs of a particular location, culture, and environment. Careful planning involving the local community and users, and employing affordable advanced technology for research, monitoring, enforcement and management, can help make the marine resources management area a success for the people and the marine environment.

7.7 Environmental considerations

This section addresses the key role of coastal resources management and why fishery stock assessment and management is the priority. It also discusses why the fundamental information collection and environmental management systems need to be put into place and how the initial stages of the coastal resources management are focused on those aspects which most seriously affect the priority objectives of redeveloping the fishery.

Coastal resources management is an integrated system of managing the uses of the coastal land and waters so that one use does not have a detrimental impact on the other use, or on overall environmental quality. Coastal land use and resource-based activities include urban, industrial, tourism, and agricultural uses, as well as aquaculture, recreation, ports and harbors, shipping, military activities, mineral extraction, oil and gas exploitation, mangrove harvesting, fishing, collecting, and waste disposal.

In addition to these human uses of the coastal resources, many other animals and many plants also depend on this coastal environment. Some of these animals have direct economic benefits for humans, such as various species of finfish, lobsters,

shrimp, and oysters. Some animals and plants produce genetic material that is the basis for pharmaceuticals of significant benefit to humans. Some animals are valuable because they are rare, unique, or especially sensitive to environmental perturbations. Many such animals and even some plants are held in high regard in different cultural traditions as guardian spirits and traditional totems. Many coastal ecosystems, such as the coral reefs, seagrass beds and mangroves found in Eritrea, are delicately balanced complex systems which can be significantly altered by human actions. If one part of the system is degraded, the rest of the system is affected. Therefore, damaging an element in this interconnected system that is not of direct economic benefit to humans can cause degradation of an economic resource, or have a detrimental affect on human health. Integrated coastal resources management provides the necessary tools to prevent such unfortunate consequences while allowing for sustainable use of coastal and marine resources.

In the context of this integrated coastal resources management system, a priority objective is protection of the economic resources in the fisheries sector. This is especially true in Eritrea, where fisheries can play a significant role in meeting the critical need for protein. The Ministry of Marine Resources is seeking to increase the catch of fish by the local artisanal fishers, increase the supply of fish to the local consumers, and potentially export some fishery products to obtain foreign exchange. In the face of such major policy objectives of expanding the fisheries sector, the management of how the fishing industry grows is critical.

Successful fisheries management is only possible with adequate information on the available stocks, and on-going monitoring and analysis of catch and effort data. For this reason, establishing an information system for fish stock assessment and management is a key priority focus of this project.

The development of a system for integrated coastal resources management proposed here will first address those areas and activities that most directly affect fisheries. Therefore, key policy statements to incorporate the principles of coastal resources management in the draft fisheries legislation and land use legislation are necessary. So too, general guidelines for environmentally sensitive coastal land use for urban, industrial, tourism, and agricultural activities are necessary to guide development on the shore side of habitats of importance to fish replenishment and juvenile recruitment. For example, use of coastal lands adjacent to mangroves, coral reefs and seagrass beds must be carefully managed so as to prevent damage to these habitats that play such an important role as nursery grounds for economically important fish stocks.

Environmental management of coastal resources and fisheries development are closely linked. This project addresses the most immediate needs of Eritrea by providing the

necessary information and analytical tools to promote sustainable use of coastal resources and, most importantly, fishery resources.

7.8 Costs and benefits

This section presents an estimate of the costs and benefits of the recommended project. The first sub-section presents a general estimate of the international donor assistance and the host country contributions to the project. The second sub-section then reviews the prospective benefits of implementing the project.

7.8.1 Costs of the recommended project

This section presents a general overview of the estimated costs of the recommended three-year project. The international donor assistance required for implementing the recommended project is estimated at approximately US$3.3 million, with approximately US$1.8 million being required for the Fishery Stock Assessment and Management Component, US$1.0 million being required for the Coastal Resources Management Component, and US$0.5 million being required for the Marine Resources Management Component. The Government of Eritrea contribution required for implementing the recommended project is estimated at approximately US$600,000, with approximately US$340,000 being required for the Fishery Stock Assessment and Management Component, US$130,000 being required for the Coastal Resources Management Component, and US$130,000 being required for the Marine Resources Management Component.

7.8.2 Benefits of the recommended project

The benefits of the recommended project are many. The fishery stock assessment and management component will ensure that Eritrea's fishery resources will be properly managed, achieving maximum sustainable yields to benefit future generations as well as the present generation and maximizing the contribution of the fishery resources to creating employment, feeding the population, and generating foreign exchange. The coastal resources management component will protect the natural coastal resource environmental quality, ensuring the productivity of the fishery, the development of the tourism industry, and the quality of life of coastal Eritreans. The marine resources management component will complement the other two project components, ensuring the maximum balanced and sustainable exploitation of Eritrea's marine resources. Each of the project components will provide the necessary technical assistance and training to ensure that the MMR staff is capable of continuing the development, management, and enforcement of the coastal and marine resources management systems established.

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While many of the benefits of the project are concerned with improving the quality of life and are difficult to measure quantitatively, other benefits can be quantified. Fortunately, the quantifiable benefits are substantial, impressive, and easily justify the costs of the project. Benefits are most quantifiable in the case of the fishery.

In assessing the benefits of the recommended project, the principal concept employed is that of opportunity cost, i.e., the cost of foregone opportunities. In particular, one wants to estimate the value of preventing over-fishing or over-exploitation of the fishery. In section 7.6.2.3 above, the general estimate of Eritrea's maximum sustainable yields of prime food fish came to roughly 20,000 mt annually, and the current domestic value of this sustainable catch was approximately US$20 million annually. This estimate took account of neither the export value of the fish nor the employment and income multiplier effects on the economy of this US$20 million income generated each year.

If the establishment of an effective fishery stock assessment and management system in Eritrea were to prevent even a 1 percent decline in the sustainable yields, the program would have saved Eritrea roughly 200 mt (or 200,000 kg) of fish every year into the future. This 200,000 kg is valued at US$200,000 per year. If we discount the revenue stream of US$200,000 per year into perpetuity at a 10 percent discount rate, then the present value of the savings due to good fishery management comes to US$2,000,000. It can quickly be seen that since the estimated cost of the fishery stock assessment and management component of the recommended project is only US$1.8 million, the present value of the project benefits is larger than the cost of the project. This outcome has assumed the most modest contribution of the project to maintaining sustainable yields, namely, that the project prevents only a 1 percent decline in sustainable yields.

Of course, there are employment and income multiplier effects as the impact of this increased sustainable production ripples through the economy. If the multipliers were only in the range of 2.5, then the value of the benefits would amount to more than 2.5 times the U.S. contribution of US$1.8 million. As noted, these calculations are based only on a portion, although the most important portion, of the value of the fish and fish products which could be extracted from the fishery, so the actual value of the benefits of the project would be substantially greater. Furthermore, if only a quarter of Eritrean fish catch were exported to regional markets at a value of US$3.00/kg, the conservative calculation of the present value of preserving the sustainable catch rates comes to US$3,000,000. Adding the multiplier effects throughout the economy, this implies that the program would yield upwards of US$7.5 million in present value,and perhaps US$10-12 million or more, depending on the value of the additional fish and fish product yields which are also preserved by good fishery management. In sum, it is clear that implementing an effective fishery

stock assessment and management system in Eritrea now, while the fishery is in relatively good shape, is an extremely good investment.

The benefits are, however, far greater than the above example shows. There are two aspects to this. First, even aside from various regional fisheries that have been virtually decimated due to over-fishing or destructive fishing practices, FAO estimates that most of the world's artisanal fisheries have been pushed beyond their maximum sustainable yields. There are many cases where, for lack of a good fishery stock assessment and management system, the world's artisanal fishery have seen reductions of 10-20 percent of their maximum sustainable yields. If the fishery stock assessment and management system were to prevent such a 10-20 percent decline in sustainable yields in Eritrea, then a US$1.8 million investment in establishing a good stock assessment and management system in Eritrea now could save the equivalent of a present value of US$20-40 million. And this does not take into account the potential export values or the employment and income multiplier effects throughout the economy. These latter effects almost certainly would increase the net present value of the project by 2-4 times. Despite the roughness of these calculations, it is clear that the project probably has a benefit-to-cost ratio on the order of 25 to 1, or even higher.

Such high estimates of benefits relative to costs are possible, principally because the Eritrean fishery has not already been over-fished, that its stocks are abundant. Most countries are striving to implement fishery management systems after their fishery stocks have already been substantially fished or already degraded. It should be noted that this is a good example of the importance of establishing a good resource management system before, rather than after, a fishery has been heavily fished. It is, of course, possible to regulate fishing effort after a fishery has been heavily fished, and perhaps even declare no-fishing zones for a period of 5-10 years to allow the fish stocks are replenished. However, restoring a fishery is a much more costly investment than preserving it in the first place. This is because when a no fishing zone is declared, then the investment costs are principally in the foregone fish yields during the years of no fishing. Several years of no fish catch at all can amount to a very substantial investment, and it often is not justified in order to raise sustainable yields by 25 or 50 percent. This is because the foregone fishing yields are an up front investment, discounted only slightly in the first years of the ban on fishing, while the increase in fish yields comes much later and are discounted over many more years. Hence, while declaring no-fishing zones may sometimes be justified or even necessary just to be able to restore a fishing industry, it is not a particularly a good investment proposition. An investment in good fishery stock assessment and management before a fishery has lost some of its potential is a high pay-off type of investment

The same approach to comparing costs and benefits of the recommended program in the stock assessment and management component can be used in reference to the

coastal resources management and marine resources management components. However, these benefits are even more difficult to measure quantitatively, and in many cases the benefits are intimately linked to the sustainability of the fishery resources. Hence, it is more appropriate to highlight some of the principal benefits which will be the product of the projects.

Coastal resources management component will contribute 1) to sustaining the productivity of the fishery resources by protecting the environmental quality of the fish nursery or juvenile recruitment habitat; 2) to protecting the environmental quality of natural coastal resources used in the tourism industry, e.g., beaches, coastal waters (for recreational swimming, boating, surfing, diving), mangroves (for bird watching), and coral reefs (scuba diving and snorkeling); and 3) to protecting the natural coastal resources which contribute to the quality of life of the coastal Eritreans, e.g., the clean water, clean air, and clean coastal land which are all valuable for recreational purposes, and open space, even just for its very existence if it is not necessarily being used every day.

The marine resources management component, establishing a multiple use management framework for the Dahlak Islands, provides the means for cultivating a growing tourism industry in a way that is compatible with the environment and sensitive to the local population. The tourists could range from divers, snorkelers, beach goers, hotel resort guests, sailors and other boaters. Income is generated from accommodations, food, transport, gifts, scuba diving, charter boating, etc. There is keen interest on the part of several live-aboard dive vessels to come and dive in the Dahlak Islands Archipelago. To tap this market, and to provide a means of generating income from the live-aboards, several options are possible. These include requiring them to use the designated diving reserves in the Dahlak Islands managed marine area and charging them a user fee to do so. The charges could be a certain amount per diver per day. In addition, if it is made convenient, then these vessels could reprovision in Eritrea. Clean water, possibly from a larger desalination plant on Dahlak Kebir is a valuable commodity that could be sold to the vessel. Food and fuel could be bought in Massawa. To make this work, a convenient docking, fueling and reprovisioning service needs to be established. Many live-aboards sell as a part of the multi-day package, several land tour excursions. Such excursions could be developed in Eritrea and income generated from these people in this way. These excursions could include historical and cultural tours to Adulis, Massawa, and maybe a traditional village, wildlife tours to the mangrove area, and so forth. These tourists would help to diversify the tourism industry in the Massawa/Dahlak area. The designated diving reserves and protected areas for wildlife, historical preservation, and other purposes all make this source of foreign exchange in the tourism industry possible.

Lastly, it is important to emphasize the significant benefits to be derived from the formal and informal project training for Eritreans. Training of MMR staff, and related

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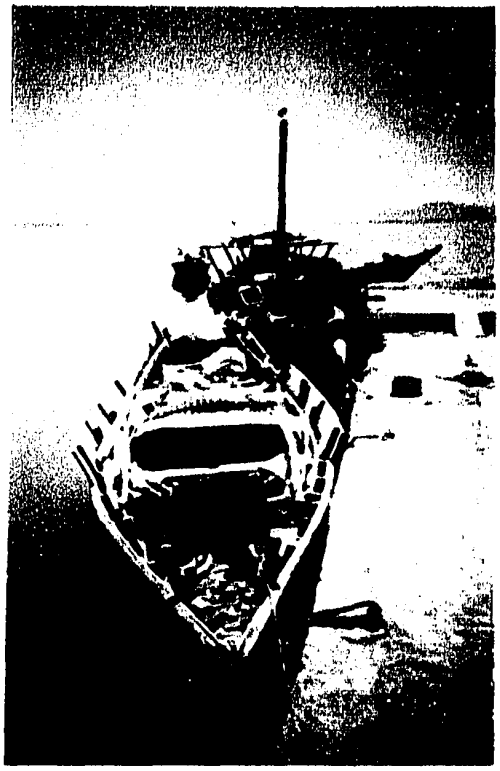
Ministry and private sector personnel, has been an integral part of the project planning process. Such training is essential in order that the coastal and marine resources management system will be implemented in such a way that it is appropriate to Eritrea culture and conditions and in such a way that the natural resource management system is itself sustainable. Building MMR institutional capability is largely inseparable from the task of training the staff required to manage and operate the data gathering, information processing, monitoring, community relations, and resource management processes. Since the recommended project focuses on providing extensive in-country training, Eritrea will benefit from this investment in human capital without having to send large numbers of people outside the country at a large expense while the country is deprived of their talent. This investment in Eritrea's human capital is the core investment which will pay dividends in the long run.

7.9 Project summary

The recommended project designed above has three key features: 1) the establishment of a fishery stock assessment and management system for Eritrea's Red Sea fishery to ensure maximum sustainable fishery yields, 2) the establishment of an integrated coastal resources management system for the Dahlak Islands Archipelago and nearby mainland coastline to promote environmentally appropriate urban, industrial, and tourist development, and 3) the establishment of a regional multiple use marine resources management system for the Dahlak Islands Archipelago to promote sound fishery development and compatible use of the marine and coastal resources. The project would provide the necessary technical assistance and training to establish and maintain a coastal and marine resources management system which would promote the continued sustainable development of these resources.

Net-making trainees in Massawa



Boats docked in Massawa.

8.0 OTHER POTENTIAL DONOR ASSISTED ACTIVITIES

The project recommended above is an essential element in assuring that Eritrea's coastal and marine resources are managed in an environmentally sustainable manner. However, it is a large project, and large projects often take a long time to be funded and implemented. Yet, the RDA Team feels that it is important that some things be done immediately if Eritrea's coastal and marine resources development process is to get off to a good start. We have, accordingly, identified some additional smaller potential international donor assisted activities of high priority which could be done quickly with minimal funding. Brief project profiles of these recommended activities are presented below.

8.1 Black-lipped oyster abundance assessment project

Project Title: Black-lipped oyster abundance assessment.

Project Description: Cultured black pearls are a high value product which may be cultured in black-lipped oysters (*Pinctada margaritifera*). French Polynesia has developed its cultured black pearl industry into a US$50 million industry since its beginnings in the early 1970s. The Cook Islands produced its first cultured black pearls in the late 1980s, and it has already become a US$10 million industry. Seeing the promise of development of black pearl culture as a way to promote economic development, creating employment and entrepreneurial opportunities for small-scale aquacultural farmers and fostering the production of a high value export commodity, USAID has funded a multi-million dollar cultured black pearl development project for Tongareva lagoon in the Cook Islands. The Asian Development Bank has also approved a multi-million dollar loan and technical assistance cultured black pearl program for Manihiki lagoon in the Cook Islands. In addition to producing black pearls, the industry also produces mother of pearl used in the jewelry and button industry. Cultured black production is a proven target for promoting economic development.

The key to being able to produce the cultured black pearl is having healthy wild stocks of the black-lipped oysters in a protected marine environment. Even if the wild stocks are not extremely abundant, within the past decade the development of oyster hatchery techniques have been developed for creating a supply of oyster shells in sufficient quantity to justify cultured black pearl production. While developing a cultured black pearl farm is an expensive and risky business venture, the returns, if successful, are extremely large. If adequate wild stocks of the black-lipped oyster were proven to exist in protected environments along the Eritrean Red Sea coast, potential foreign investors could be found in the Gulf countries, in Japan, and perhaps even in French Polynesia. Proving the existence of the resource base for the development of the industry would also be a basis for designing proposals to international donor agencies to seek assistance for this development opportunity.

It is well known that Sudan has wild stocks of the black-lipped oyster along its Red Sea coast. Eritrea also has some wild stocks of the black-lipped oyster. Shells can be found around the Dahlak Islands, and some local jewelry makers incorporate the black-lipped oyster mother of pearl into their creations. It is therefore appropriate for a trained oyster biologist to make an assessment of the abundance, health, and environments of Eritrea's black-lipped oyster populations. This assessment would determine if it is reasonably certain that a cultured black pearl industry could be developed in Eritrea. If so, it would open the opportunity for private investments or international donor assistance projects in developing the industry in Eritrea. An economist experienced in the pearl oyster aquaculture industry could then be contracted to prepare an investment prospectus for potential foreign investors and a project profile for potential international donor assistance agencies.

Project Objective: The project would provide for a trained oyster biologist to visit Eritrea to survey black-lipped oyster abundance, health, and environments in the Dahlak Islands Archipelago. The oyster biologist would survey the entire region, selectively diving with scuba gear in promising areas, and assess the possibility of developing a cultured black pearl farming activity in Eritrea. If the biologist's assessment of the technical opportunities is positive, then a pearl market economist would prepare a draft investment prospectus which could be used by the Eritrean Investment Center to solicit interest from potential private investors. The economist would also prepare a draft project profile which could be used by the Eritrean Ministry of Marine Resources to solicit interest from potential international donor assistance agencies.

Project Scope of Work:

1. A pearl oyster biologist would travel to Eritrea to assess the abundance, health, and environments of black-lipped oysters in Eritrean Red Sea waters in the Dahlak Islands Archipelago.

2. The pearl oyster biologist would survey the entire area, diving selectively, to assess the potential for utilizing the wild stocks of black-lipped oysters in cultured black pearl culture.

3. The pearl oyster biologist would write a draft report on his/her findings to be prepared and sent by international express mail to the funding agency in Eritrea within 15 days after returning to the U.S.

4. If the pearl oyster biologist reports that Eritrea has a high potential for developing a cultured black pearl farming activity, then a pearl market economist would be activated; if the pearl oyster biologist's report on the potential is negative, then the activity would end there.

5. If the pearl market economist is activated, then the economist would prepare a draft investment prospectus for potential investors for use by the Eritrean Investment Center and would prepare a draft project profile for potential international donor assistance agencies for use by the Eritrean Ministry of Marine Resources.

6. The pearl market economist's draft investment prospectus and draft project profile will be completed and sent, along with the final version of the oyster biologist's report, by international express mail to the funding agency in Eritrea within 30 days after the pearl oyster biologist's draft report is completed and mailed.

7. The activity will take a total of 75 days to complete.

Estimated Cost of Project: US$58,000.

8.2 Marine reserve area identification project

Project title: Marine reserve area identification.

Project description: For over twenty years, international marine scientists and conservationists have been proposing the creation of a marine resources management plan for the Dahlak Islands Archipelago in the Eritrean Red Sea. The new government of Eritrea has committed itself to carrying out these visions. It has already laid the groundwork for this by including provisions in its draft fisheries legislation regarding marine reserves, or marine resources conservation areas. In addition, initial work has been done to gather resource survey information on these islands.

At the same time, the Ministry of Marine Resources seeks to increase the fish productivity of artisanal fishermen that fish in the Dahlak Islands Archipelago. In addition, there is increasing pressure from international companies to begin fishing in these productive waters using trawl nets. Trawling can cause significant damage to coral reefs and other bottom ecosystems if used in areas too shallow or too fragile for that type of gear.

To have a sustainable fishery in the Dahlak Islands area, it is necessary to manage the multiple uses of this area. This can be done through the establishment of a marine resources management area with a multiple use management plan for the Dahlak Islands Archipelago. The marine area would be zoned so that fishing and gathering of other marine life would be permitted in some zones, while there would be certain other zones where fishing would be prohibited so that fish stocks would be allowed to be replenished through natural recruitment. These areas include coral reefs and seagrass beds, and other associated communities. With an increase in fishing pressure, the first step in setting up a marine resources management area is for the Ministry of Marine Resources to identify those areas within the Dahlak Islands

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Archipelago that should be set aside as marine reserves where no fishing is to be allowed.

Project objectives:

The project report will provide an analysis and recommendation of those areas in the Dahlak Islands Archipelago that serve as recruitment and replenishment areas for fish to be set aside as non-fishing marine reserves as part of the Dahlak Islands Marine Resources Management Area.

The product will be in two forms: charts identifying the location and coordinates of those areas recommended for non-fishing marine reserves, and a narrative describing the resources, habitats, and other characteristics of those selected reserve areas. A recommended management plan for these areas will also be produced.

This can serve as the basis for the establishment of the Dahlak Islands Marine Resources Management Area, and as a valuable management tool for the Ministry of Marine Resources to achieve its objective of a sustainable fishery and tourism industry in these islands.

Project scope of work:

A preliminary marine resources survey is needed in order to make recommendations for establishing certain areas of the Dahlak Islands Marine Resources Management Area as marine reserves where no fishing is allowed. These areas are ones that through preliminary survey work present the best potential as fish recruitment or replenishment areas.

The marine biologist/marine resources management specialist will be required to undertake several activities including:

1. Evaluate all existing data on marine resources and habitats of the Dahlak Islands Archipelagic waters and select any potential sites that serve as recruitment habitat for fish.

2. Conduct aerial and boat surveys in the Dahlak Islands archipelagic waters to check these and identify other areas that potentially serve as replenishment areas.

3. Conduct interviews and initiate discussions with the local fishing community as to the needs and benefits of setting aside these areas.

4. Develop a plan of action for the Ministry of Marine Resources Department of Marine Research to monitor and enforce these non-fishing reserve areas.

5. Prepare computer generated charts identifying the location and coordinates of those areas recommended for marine reserves, a narrative describing the resources, habitats, and other characteristics of those selected reserve areas, and a recommended management plan.

The marine biologist/marine resources management specialist shall have experience in marine resource surveys with special emphasis on marine fish habitat characterization. The specialist shall also have experience in marine resources management and be able to prepare accurate computer generated charts of the marine resources management areas. The specialist shall bring a complete set of dive gear, except dive tanks.

The specialist will work in Eritrea for five weeks. Four days will be spent in the round trip travel between the United States and Eritrea. Two days will be spent after return to the U.S. on report preparation. The report will be prepared in English. Also, a local representative of the Ministry of Marine Resources who is familiar with the relevant governmental and nongovernmental institutions and people will be available to act as a guide and interpreter and to assist in making arrangements, requesting and obtaining information, and otherwise assisting in managing logistics for the specialist. It will be important to have a female staff member of the MMR working with the specialist, especially during the time when the specialist is working with the local community.

Estimated Project Cost: US$65,000.

8.3 Design of interim commercial fisheries regulations project

Project Title: Design of interim commercial fisheries regulations.

Project Description: To create or adapt an interim set of fishery regulations for Eritrea which will allow for a conservative industrial harvest of the country's coastal waters. The gear and area restrictions could be modified as stock assessment information justified the necessary changes. The object of the restrictions would target industrial foreign fishing operations, yet conform to Eritrean law and management policies.

Project Objective: At the present time, Eritrea's fish stocks have enjoyed a 30 year period of little or no major fishing pressure. Because of this harvest grace period, the production potential (at least in the short-term) looks very promising and present catch rates (CPUE's) have been estimated as very high. Yet, the observed target catch of fish harvested by the artisanal fishermen seem to be primarily reef species which are long lived with slow recruitment rates. For these reasons, the populations of such species of fish can be very sensitive to high fishing pressures. Although the catch

rates of artisanal fishermen may be quite high, their harvest efficiency (fishing power), is still relatively low. Therefore, for the present, the domestic effort on existing fish stocks has been estimated by FAO and others to be below maximum harvestable rates (MSY).

The government of Eritrea has identified its fishery stocks as a national resource which can contribute to domestic food supply, employment, and export trade. This need for export trade is creating pressure to "sell-off" those sustainable yields in excess of those which can currently be harvested or consumed locally. Not only is there pressure for export trade, but there are also political issues related to promoting regional "good will", as numerous neighboring countries are anxious to resume previous fishing relationships and operations which were stopped by the war.

Unfortunately, there is available in the Red Sea alone enough advanced fishing technology and power to have a serious impact on Eritrea's coastal resources if allowed to fish in an unregulated manner. Because of political and economic pressures, it is getting more and more difficult for the MMR to maintain its conservative approach to managing its fish stocks by not allowing foreign industrial fishing. The next best option would be to allow limited and regulated foreign fishing effort which could be controlled. What would be asked of the foreign fishing ventures would be no more than what those same activities would have to comply with if in fact their operations occurred in other zones of managed fisheries around the world (i.e., Australia, South Pacific, etc.).

Project Scope of Work: In the course of approximately three months, one technically qualified person would review and identify applicable and existing interim fishing and gear regulations which could be utilized by the MMR to control mechanized foreign and domestic fishing operations until present and planned stock assessment projects can justify reductions or strengthening of limitations. The identified laws would be practical regulations related to vessel operations, deployment of fishing gear, gear characteristics, and areas of fishing activity. One fisheries regulations specialist, versed in international law, fishery management procedures, and world fishing technology, would be required for sixty (60) work days, including approximately 5 days in the U.S.A., 6 days visiting FAO in Rome, 6 days engaged in regional travel, approximately 6 days in transit, and the balance of time in Eritrea.

Estimated Project Cost: US$72,000.

8.4 Coastal resources management guidelines project

Project title: Coastal resources management guidelines.

Project description: Reconstruction and development of Eritrea's coastal area is moving rapidly as the country rebuilds from several decades of war. There is a critical need to manage this growing and changing coastal resource use in order to protect the sustainability of this coastal development, in terms of fisheries, tourism, public health, quality of life, and conservation of biological diversity.

The Ministry of Marine Resources has stated its objective of establishing a system of integrated coastal zone management to address this need. However, the supporting policy statements in draft fisheries or land use legislation have not yet been developed.

The Ministry has taken the first step of creating the institutional mechanism for coastal resources management in its Coastal Zone Management Section. This Section is responsible for reviewing any development or resource use that potentially affects coastal or marine environmental quality. However, this Section does not have trained staff or general guidelines for managing coastal development of different types.

This project will bring a coastal resources planning specialist to Eritrea to work with relevant government officials to produce an analysis and recommendation of appropriate integrated coastal zone management policies and coastal development guidelines for Eritrea. This will be useful and timely for the Ministry of Marine Resources, as well as other relevant ministries, in addressing the pressing needs of reconstruction and development of the coastal area, including the urban centers of Massawa and Assab, as well as the smaller coastal communities.

Project objective: The project report will provide an analysis and recommendation of appropriate general principles of integrated coastal zone management for the purposes of assisting in developing national coastal zone management policy. The report will also include preliminary general guidelines for tourism, industrial, urban, and agricultural uses of the coastal lands.

This will serve as a resource and discussion document for the Ministry of Marine Resources and the proposed Provisional Committee for the Protection of the Marine Environment. This Committee includes representatives from the various agencies and ministries that are involved in the coastal and marine resource use including the Ministry of Marine Resources; Ministry of Trade, Industry and Tourism; Ministry of Finance and Development; Ministry of Mines, Energy, and Water Resources; Ministry of Agriculture; Ministry of Defense; Ministry of Provincial Administration; and the Ports and Maritime Transportation Authority. Each of these ministries and agencies

will be able to use these policy recommendations to incorporate in their own enabling legislation, and in promulgating rules and regulations for activities in their jurisdiction.

Project Scope of Work:

The coastal resources planning specialist will be required to undertake several activities, including:

1. Provide an analytical description of Eritrea's coastal resources.

2. Assess the current status of these coastal resources, current and proposed uses, current environmental status, and identify current and potential impacts of coastal resources use.

3. Review current institutional and policy constraints on implementing integrated coastal zone management to achieve sustainable use of coastal resources.

4. Assess the policy, regulatory, institutional and planning requirements for ensuring sustainable coastal resources development.

5. Recommend appropriate policies and development guidelines for integrated coastal zone management of different uses of coastal resources including urban, industrial, tourism, agriculture, aquaculture, mineral extraction, forestry, fishing and gathering.

The coastal resources planning specialist will work in Eritrea for five weeks. Four days will be spent in the round trip travel between the United States and Eritrea. Two days will be spent in preparation, gathering resource documents and appropriate model policy and regulatory guidelines. Four days will be spent after return to the U.S. to revise the project report based on comments from the Eritrean government and the funding agency, and to complete the report preparation. The report will be prepared in English. Also, a local representative of the Ministry of Marine Resources who is familiar with the relevant governmental and nongovernmental institutions and people will be available to act as a guide and interpreter and to assist in making appointments, requesting and obtaining information, seeking and providing security information, and otherwise assisting in managing logistics for the specialist.

Estimated Project Cost: US$42,000.

8.5 Evaluation of distant water fishing fleet proposals project

Project title: Evaluation of distant water fishing fleet proposals.

Project description: Eritrea's infrastructure, destroyed and degraded during the war, are being rebuilt, but the country requires much outside assistance. Eritrea's fisheries, once an active sector of the economy, have been under-exploited for most of the last twenty years. This fact is not lost for many distant fishing fleets and, in view of the country's requirements for hard currency, the Ministry of Marine Resources is under pressure to give permission to trawlers to start operating in Eritrean waters. The MMR is charged with the sustainable use of fisheries resources that maximizes economic benefits for the country.

The country is endowed with a wide continental shelf area around the Dahlak Islands Archipelago where a variety of highly desirable stocks have sustained a traditional fishery for a long time. There are areas at the continental slope and along the Dankalia coast where trawling operations were carried out in the past. There is an information void surrounding these stocks and the MMR does not have sufficient trained manpower to carry out its mandate of managing the nation's marine resources. Requests and proposals have been submitted to the MMR to carry out "scientific trawling" operations wherein the distant fleet does commercial trawling to "cover costs" and gives "data" to the MMR. The Ministry does not have the expertise to evaluate such proposals, nor does it have the resources to design trawling guidelines or develop the control, monitoring and surveillance (CMS) structure and manpower to ensure compliance with such guidelines even if such guidelines were to be adopted right away. The MMR requires immediate assistance in evaluating such proposals.

Project objective: The project will provide the MMR with an interim set of guidelines for the protection of marine resources from destructive fishing practices by distant water fishing fleets. The project will also provide the MMR with the nucleus of a CMS system.

The proposed project will give the MMR the ability to draw up guidelines for distant fleet operations. In particular, the MMR will be able to evaluate proposals from such companies on their technical, scientific and economic merits.

Project scope of work:

The fisheries biologist will examine the proposals submitted by the two ventures currently authorized to carry out survey and fishing operations and will track their operations, extracting model guidelines which may be used by the MMR for subsequent joint ventures. More specifically, the fisheries biologist will:

1. Examine and evaluate current proposals of distant fleet fishing operations and submit a critique to the MMR.

2. Provide guidelines as to where the location of trawling operations are needed to fill information gaps for purposes of the MMR.

3. Suggest the definition of areas where trawling operations may not be carried out. This shall be consistent with the conservation mandate of the MMR and the Marine Resources Management Area around the Dahlak Islands Archipelago.

The fisheries biologist shall have a background and experience in evaluating the effect of the industrial fishing operations in fisheries with comparable bathymetric features and shall have the ability to evaluate proposals submitted by distant fleet operations in joint ventures. The specialist will work in Eritrea for 5 weeks and in the U.S. for 3 days in departure preparation and 2 days in report preparation, with 4 days in travel status. An Eritrean representing the MMR will assist the specialist in carrying out the tasks while in the country by making arrangements, requesting and obtaining information and overall logistic support.

Estimated Project Cost: US$57,000.

8.6 Ministry of Marine Resources research vessel project

Project Title: Ministry of Marine Resources research vessel.

Project Description: At present, the Ministry of Marine Resources does not have a vessel of its own. The vessel which the MMR is using is a 10 meter open skiff which belongs to the Eritrean Navy and is on loan to them when not involved with Navy activities. Although there are donor assisted projects which have boats, these projects and the boats involved are targeted for activities within the artisanal fishery. The project would supply the MMR with a modest vessel which is not project oriented and available for research activities and investigations.

Project Scope of Work:

The project will supply a vessel to the MMR with the following characteristics:

1. Length: approximately 25 to 30 ft.

2. Beam: greater than 8 ft.

3. Other Characteristics: trailerable fiberglass, self-bailing, deep-vee/planing hull (USCG marine safety standards); with engine well; rack and pinion steering system;

center consul with windshield, power controls and steering; two or more water-tight storage compartments totaling at least 75 cu. ft.; removable sun shade mounted on center steering consul (not attached to sides of the boat); running lights with strobe.

4. Power: 2 X 85 hp outboard engines with electricity generating capability; spare parts and repair capability must be available in Eritrea; 100 gallon fuel capacity.

5. Navigation Equipment: compass with light; hand-held GPS unit (global-positioning-satellite locator).

6. Electronics: depth flasher (100 ft.) with transom mounted transducer; dry-paper recording depth recorder, 1000 ft. depth range, range expander, white line, 100 rolls of paper, high frequency (150-200 kHz) transom-mounted transducer; mobile SSB radio with base unit (or capability to communication with Navy and port) with antennas.

7. Trailer: EZ-lift style with running lights, and vehicle mount ball-hitch to include vehicle hitch assembly.

Estimated Project Cost: US$98,000.

8.7 Other potential international donor assisted activities

There were several other potential project ideas which warrant attention, even though brief project profiles were not developed for them as were done for the above small projects. These activities include the following:

1. Catering school project to train staff for an expansion of tourism.

2. Joint agricultural and marine resource project to determine if there is some appropriate and economically viable domestic use for Eritrea's small pelagic (sardine and anchovy) resources.

3. A fish quality improvement project, perhaps tied to free market initiatives.

4. Assistance to the Technical School, Asmara, including the possible renewal of U.S. assistance.

These are a few examples of the many small project activities which could be done relatively quickly on a small budget, but which could make a substantial contribution to assisting Eritrea in its reconstruction and development efforts, particularly in developing its coastal and marine resources.

9.0 SUMMARY AND CONCLUSIONS

Eritrea has significant opportunities to develop its coastal and marine resources. Its artisanal fishery in the Red Sea, particularly in the Dahlak Islands Archipelago, could provide employment to several thousand fishers and add substantially to the domestic food supply, while, at the same time offering opportunities for earning substantial amounts of foreign exchange through fish exports to various regional markets. Similarly, Eritrea has strong tourist development opportunities, again, particularly in the Dahlak Island region. The main constraint on the sustainable development of Eritrea's fisheries and tourism industries is its lack of a system to manage these resources in a sustainable manner and the lack of the skilled personnel to manage such a coastal and marine resources management system.

Accordingly, it is strongly recommended that international donor assistance be forthcoming to assist Eritrea, and in particular Eritrea's Ministry of Marine Resources in providing the necessary technical assistance and training required to establish and maintain a fishery stock assessment and management system for its Red Sea fishery, an integrated coastal resources management system first for the Dahlak Islands Archipelago and surrounding regions and later to be extended to the entire coastline, and a regional multiple use marine resources management plan for the Dahlak Islands Archipelago. This report has carefully designed a comprehensive three year international donor assisted project to address these needs. The project has been developed modularly, so that each of the major components could be addressed separately or sequentially. With such assistance, there is little doubt that Eritrea can develop a management system which would sustain its coastal and marine resources productivity and maximize its sustainable employment, food supply, and foreign exchange earnings to be reaped from these valuable resources.

In addition to designing the recommended large, multiple year international donor assistance program for assisting Eritrea in coastal and marine resources management, several small, well-targeted, high-payoff project activities have been designed to assist the MMR in taking some initial steps in monitoring, regulating, and managing its coastal and marine resources and in identifying potential private or international donor investment prospects.

10.0 APPENDICES

Appendix A. Scope of work

Appendix B. Itinerary

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Appendix E. Results of Workshop

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Appendix A. Scope of work

Eritrean coastal and marine resources assessment and project identification

I. Background:

While Eritrean agriculture operates on average on a below subsistence level, Eritrea's coastal and marine resources including approximately 20,000 of territorial waters represent an under utilized resource with considerable scope for expansion of sustainable production and quick payoff -- if a well designed, coordinated program to simultaneously protect and sustainably exploit the resource is mounted quickly.

A 1992 draft survey by FAO indicates that a total of 2,615 individuals were engaged in fishing in one way or another on the Red Sea Coast and off-shore islands. Due to the destruction of the war and lack of investment, the equipment and methods of these fishers are very poor and their productivity is very low. Fishing was effectively (nearly) banned for the last 15 years because of severe security measures along the coast. Although accurate estimates of Eritrea's considerable marine resources remains to be made, preliminary FAO estimates are that the current annual catch of around 2,000 tons may be sustainably increased to somewhere in the neighborhood of 70,000 tons per year.

The Department of Marine Resources and Inland Fisheries (DMRIF) has outlined its priorities for the fishery sector as follows:

- Increasing the supply of fish as a valuable source of protein to the Eritrean people.
- Improving the incomes and quality of life of the fishing community.
- Generating foreign exchange through the export of fish or marine products for which no domestic market exists.
- Establishment of conservation measures, especially for the extensive Coral Reef which is the most productive region of Eritrean territorial waters.
- Establishment of Marine Parks.

II. Scope of Work:

The Contractor shall perform an initial coastal and marine resources assessment and project pre-identification for Eritrea including but not necessarily limited to the

following tasks. The economic and environmental assessment of Eritrea's coastal and marine resources is required to determine the development potential, to identify key policy, to identify some high payoff development project alternatives including the development of an on-going resources and environment data collection and monitoring system to support the sector development strategy.

Task including but not limited to:

1. Based on a review of the available data and literature and on first hand visits to the coastal and marine areas, provide an analytical description of Eritrea's coastal and marine resources, the current status of the fisheries resources, the level of exploitation, fishing technologies employed, employment and income generated, capabilities of the Department of Marine Resources and Inland Fisheries (DMRIF) and the on-going and planned projects and programs of DMRIF, FAO and other donors.

2. Identify the constraints on and opportunities for coastal and marine resources development.

3. Identify and assess the current environmental status of the coastal zone, identify current or potential impacts of fishing, tourism, urban development, and pollution.

4. Review current institutional and policy constraints on implementing the sustainable development of the coastal and marine resources and suggest options for removing or reducing these constraints.

5. Assess the management, research and education requirements for ensuring sustainable development of the coastal and marine resources and recommend an investment and policy strategy for meeting these requirements. This task shall include assessment of the DMRIF proposal to establish a Marine Technology Training Center in Hargigo (south of Massawa) describing the potential scope of such a center and the feasibility of it. The Hargigo Center proposal shall be weighed against its cost and compared to other potential alternatives for developing the required skills in the public and private sectors for the development and conservation of Eritrea's coastal and marine resources.

6. Recommend a feasible data collection and resource monitoring system (including the approximate cost and how to institute) to support sustainable exploitation of the coastal and marine resources.

7. With the description of on-going and planned DMRIF and donor programs as background, identify several initial project alternatives which may be financed

either by USAID and/or other donors, which have immediate high-payoffs and contribute to the environmentally sustainable development of the coastal and marine resources.

8. Prepare a preliminary development strategy and plan for the environmentally sustainable development of Eritrea's coastal and marine resources.

Prior to departing the USA, the Contractor's team shall attempt to make contact with DMRIF, UNDP, FAO, and all other donors involved in or potentially interested in providing assistance to develop and conserve Eritrea's coastal and marine resources. Contact shall be by telephone and all other feasible and appropriate means. The Contractor shall obtain all possible reports, project papers, and other documents relating to other donor plans relevant to this scope of work. The Contractor shall plan the team's travel as appropriate to allow one or more team members to visit with other donors on the way to and/or while returning from Eritrea to discuss development options, share information, or plan future discussions.

III. Team Composition and Level of Effort:

The Contractor shall field a four person team consisting of the following experts:

Team Leader/Economist	30 days
Marine Biologist	25 days
Coastal Resources Planner	25 days
Vocational Training Spec.	25 days
Total	105 days

In addition, The Contractor will employ Eritrean Specialists as required in such specialties as marine sciences, import/export, and interpreters for a total estimated of 50 work days.

VI. Reports:

Draft Report. Prior to departing Eritrea, The Contractor's team shall provide copies of the complete draft report to DMRIF and USAID, make a verbal presentation at a one day workshop for top PGE officials, and collect comments for incorporation in the final report. Within two weeks after the departure of the Contractor's team from Eritrea, USAID/Eritrea will fax USAID and any PGE written comments on the draft report to the Contractor's home office.

Final Report. Within three weeks after receiving the fax comments from USAID/Eritrea, The Contractor shall send the following numbers of copies of the Final

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Report: (1) 50 copies to the USAID office in Eritrea by express delivery (DHL or equivalent) for distribution to PGE officials and other donors in Eritrea, (2) 10 copies to AFR/EA for distribution to AID/W offices, and (3) 10 copies to the Director, REDSO/ESA, REDSO UNIT 64102, APO AE 09831-4102.

Appendix B. Itinerary

29 August 1993, Sunday

1. Rowntree departed Sacramento enroute to New York.

30 August 1993, Monday

1. Rowntree met with Basem Khader, UNDP/GEF Executive Co-ordinator, to discuss UNDP and GEF activities and proposals for work in Eritrea and the Red Sea area.

2. Rowntree met with Charles McNeill, UNDP/GEF Special Projects Officer, to discuss the UNDP/GEF Eritrea biodiversity survey project proposal. McNeill shared project proposal reports and documentation and suggested that the proposal was very likely to receive funding approval, especially in view of the importance of environmental activities throughout the Red Sea region.

3. Rowntree traveled overnight to Rome.

4. Tarnas departed Hawaii enroute to Rome.

31 August 1993, Tuesday

1. Rowntree arrived in Rome and met with Ross Shotton, FAO Fisheries Resources Officer, who had worked on the FAO/TCP Project activities in Eritrea. They had long, fruitful discussions, and Shotton shared many older and more recent reports and documents regarding Eritrean fisheries resources.

2. Jurick departed Sacramento and Moussalli departed Ottawa enroute to Rome.

1 September 1993, Wednesday

1. Rowntree met with Ross Shotton, Hideki Moronuki, FAO Project Operations Officer, and Alain Bonzon, FAO Fishery Planning Analyst, all of who had worked on the FAO/TCP Project. There was fruitful discussion of the Eritrean fishery development issues, UNDP and FAO project activities, and related issues.

2. Rowntree met with Jurick, Moussalli, and Tarnas after they arrived in Rome. Rowntree shared information and documents received in New York and in Rome. The Team held its first Team Planning Meeting.

2 September 1993, Thursday

1. Team members held further discussions of the FAO reports and the project mission and objectives.

2. The Team traveled from Rome to Asmara, where they were met by George Jones, USAID Coordinator, USAID/Asmara.

3 September 1993, Friday

1. Morning briefing by George Jones regarding USAID policy, and present USAID activities in Eritrea, and the Team's mission in Eritrea. At this and following briefings during the day, the Team was joined by John Flynn, Chief, Agriculture and Natural Resources Division, USAID/REDSO/Nairobi.

2. Late morning briefing by Joseph P. O'Neill, Charge d'Affaires, U.S. Embassy. O'Neill's comments related to the general political environment in Eritrea and in the region and to activities relating to economic development.

3. Team members met with Saleh Meky, Minister, Ministry of Marine Resources (MMR), George Jones, Heike Rau, Projects Coordinator, and Rediet Tsehaye, Biologist and the team's principal guide during our time in Eritrea. The Minister emphasized the following priorities for the marine resources: 1) feeding Eritreans, 2) the export potential of fish and fish products, and 3) employment. The Minister emphasized the following needs: 1) fishery stock assessment work, 2) technical training for fishermen, 3) concentrated training for Ministry staff, and 4) infrastructure needs. The Minister emphasized the following Ministry responsibilities: 1) coastal zone management, 2) fishery development and management, both for domestic use and for export, and 3) environmental protection. The Team shared their expectations for the mission.

4. Rediet Tsehaye, MMR Biologist, was the Team's principal guide and interpreter throughout the field activities. She was assisted in arranging appointments and schedules, in obtaining documents and copies, in facilitating discussion, and in interpreting local politics and culture for the Team. She was extremely helpful and was with all or part of the team for most of the activities listed below.

4. Team members met together to discuss meeting to discuss the format of the proposed workshop.

4 September 1993, Saturday

1. Team met with John Flynn to discuss potential role of USAID and possible avenues of funding for Eritrean coastal and marine resources development.

2. Team met with Heike Rau at the MMR offices. She showed us an office which we could use and introduced us to other MMR staff. Discussions were held regarding travel plans to Assab, Massawa, and the Dahlak Islands. The Team identified those GOE and other contacts and meetings which the MMR would arrange. Plans for the coastal and marine resources workshop were explored.

3. The Team met with Judith Appleton, FAO Nutrition Consultant, to discuss her contributions to and observations on the FAO/TCP Sector Review.

4. The Team read and review documents.

5 September 1993, Sunday

1. The Team met again with Judith Appleton to continue discussions related to the FAO/TCP Sector Review findings, focusing principally on fish marketing and consumption in Eritrea.

2. The Team read and reviewed documents.

3. The Team was given a tour of the region surrounding Asmara by Minister Saleh Meky during the afternoon. The Minister shared his views on Eritrean history, politics, and culture, and many coastal and marine resource development issues were discussed.

4. The Team began planning for workshop, assignment of report preparation responsibilities, and design of report.

6 September 1993, Monday

1. Team members, joined by John Flynn for the day, met at MMR.

2. Team members toured and surveyed the equipment at the MMR cold storage facility. Although no fish were on hand, the staff was present to discuss cold store operating procedure.

3. Team members toured the Ministry market facility. The facility was empty but people were in the process of cleaning.

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4. Team members toured the Red Sea Fishing & Marine Products market facility. Fresh fish was being sold and butchered/filleted to order during the visit. The Team had the opportunity to meet and talk with Taha Sirag M. Kamel, General Manager of the Red Sea Fishing Cooperative. Discussions related to the Cooperative's artisanal fishing operation, future plans, marketing opportunities, and present needs. The team members also met with the shop manager, Osman Idris, to discuss marketing issues.

5. At the University of Asmara, Jurick and Moussalli met with Zakaria Abdula Karim, Chairman of the Marine Biology and Fisheries Department, and Tadesse Mehari, a microbiology instructor. The professor explained that the course work emphasized practical testing procedures usable in all sorts of bio-analytical work (e.g., water quality, health, marine, etc.). The Team obtained the program of study for marine biology degree students.

6. At the University of Asmara, Rowntree and Tarnas met with Mr. Mehari Tewolde, Chairman of Department of Economics. The professor discussed numerous aspects of the Eritrean economic situation, including macroeconomic issues as well as issues relating to the coastal and marine sector.

7. Jurick met with the Measho Gebretnsae, Director of the Technical School, Asmara. The school was founded in 1957 with the assistance of the U.S government. Discussion focused on the role of the technical school in the development of Eritrea.

8. Team members met with Mokonen Habtezion, Head of Technical Services, Department of Ports of Maritime Transport. Mr. Habtezion briefed the team about plans to revitalize the port of Massawa. Discussions related to master plan development, aids to navigation, and shipping safety. Specific issues related to coordinating port development plans with town plans in Massawa and pollution control and enforcement programs being considered in Eritrea. Mr. Habtezion agreed to prepare data on cargo throughput for the Team.

<u>7 September 1993, Tuesday</u>

1. Team members met with the General Manager of the Eritrean Investment Center, Tekie Beyene. The group discussed the role of the Investment Center in fishery development of the country. Several specific private investment proposals were discussed in detail.

2. Team members met with the Minister of Trade, Industry and Tourism, Ogbe Abraha. The Minister discussed the present policies related to the development of fisheries and coastal tourism.

3. Team members met with MMR Head of Foreign Markets, Woldegabriel Tesfamariam. The Team was briefed on present and potential foreign investment proposals and obtained information on specific joint venture agreements for review.

4. Team members met with Michael Askwith, Chief of the UNDP Liaison Office. Askwith briefed the group on UNDP activities in the country. Rowntree remained at the office to review the UNDP library for additional information.

5. Tarnas, Jurick, and Moussalli met with Gabriel Tzeggai, Head of the Department of Urban Planning and Development in the Ministry of Provincial Administration. The group discussed major objectives and capabilities of the department, and the working relationship with provincial governments relating to planning needs.

6. Team members met with Worku Testamicael, Secretary, Tourism Department, Ministry of Trade, Industry and Tourism. The group was briefed on the planned priorities of tourism development in the country. The discussion focused on coastal and marine tourism development and on policies regarding foreign investment. The status of the developing Tourism Master Plan for the Massawa coastal region and the Dahlak Islands was described.

<u>8 September 1993, Wednesday</u>

1. Team members met with the Tikie Tesfai, Head of the Energy Department, Ministry of Energy, Mines and Water Resources. The group was briefed on the Ministry's plans to expand power and water to the coastal regions of Eritrea and how those plans related to anticipated coastal and tourism development. The group discussed environmental issues relating to coastal power and water development as well as alternative energy sources (i.e., solar and geothermal) being considered. Agricultural water issues were discussed as well as potential oil exploration. A good deal of the discussion related to the environmental policy which all ministries have been requested to prepare. The individual ministry policy plans will be reviewed by the Ministry of Finance and Development and will be incorporated into a National Environmental Policy. Various other issues of environmental concern were also discussed.

2. The Team held a planning meeting in preparation for the facilitation workshop.

3. Team members met with Ghebre Sellasie, Head of the Department of Development. The group was briefed on major government objectives relating to fisheries development as well as major issues and concerns. A major topic of discussion related to the role of foreign investment and assistance in the planned development process. Specific areas of development and training needs were discussed.

4. Team members met with Tesfai Ghermazien, Minister of Agriculture, to discuss agricultural activities and development plans in the coastal regions. The Minister suggested that the coastal lowlands had the most productive soil in the country and were therefore a prime area for agricultural expansion. A major problem related to a general lack of water in the lowland areas. Issues relating to planned water storage development and siltation problems were openly discussed. Other topics discussed related to educational needs of the country, Dahlak Kebir Island, and the existing agriculture extension program network. Although fish nutrition and cooking had been incorporated into the extension home development program, the Minister agreed that this training concept could be expanded.

9 September 1993, Thursday

1. The Facilitation Workshop on the Management of Coastal and Marine Resources for Sustainable Development was held during the morning between 8:00am and 12:00noon. Sixteen Eritrean government officials, private individuals, and policy leaders attended the workshop. David Tarnas acted as the workshop facilitator and John Rowntree performed the task of workshop recorder. Jurick and Moussalli acted as technical support to aid and stimulate group discussion. Those Eritreans present represented almost all government development sectors involved in coastal resources as well as University of Asmara and private interests. The workshop was structured to channel group discussion into four major areas: Future Visions of the Coastal and Marine Resources; Constraints, Conflicts, and Challenges associated with the identified visions; the anticipated Eritrean Action Plans to deal with those identified visions and existing International Donor Programs helping to realize the identified visions; and a discussion of the Next Steps or the Priorities for Promoting the Sustainable Development of Eritrea's Coastal and Marine Resources. A full list of attendees and identified visions, conflicts, action plans, programs, and priorities can be found in Appendix E.

2. The Team held a meeting to critique and summarize the workshop. Comments following the workshop were very positive and the Team viewed the workshop discussion and results a success. There was a Team consensus that a full day meeting could have produced more information, but that the workshop was very fruitful. Such workshops could be employed by future project development teams.

3. The Team met with Kifle Woldeselassie, MMR Project Manager for the Semhar Project. The group discussed the proposed activities of the Semhar Fisheries Project as well as those additional donor assistance projects which will complement the Semhar Project. Other topics discussed included the MMR position on fish price controls and training projects.

4. The Team met to plan activities while in Massawa and Dahlak.

10 September 1993, Friday

1. The Team traveled to Massawa by car.

2. The Team toured MMR facilities in Massawa. Chris Hillman and his MMR counterpart, Meharl Gebre, joined the Team for Dahlak portion of the investigation.

3. The Team travel to the Dahlak Islands by boat and secured lodging on the major island of Dahlak Kebir.

4. The Team held discussions with Chris Hillman on issues relating to Dahlak Islands tourism and fisheries.

11 September 1993, Saturday

1. Team members met with the local fisheries cooperative board member, Muhammad Ramadan, to discuss Dahlak fisheries activities. Other issues discussed included particulars involving the fishery cooperative, fishery needs, and fresh water sources. Moussalli acted as the Arabic translator.

2. On the island of Dahlak Kebir, Jurick and Moussalli traveled to the village of Jemhille by car to meet with the Head of the Dahlak Fisheries Cooperative, Abdo Ahmad Ali, to continue discussions relating to the Dahlak fishery activities. At the village, numerous fishermen openly participated in the discussion. The fishermen took the team members to the planned jetty site which had been identified by the fishermen. At the site the team members inspected several sambucs (fishing boats). The team members returned to the village to continue discussions. Issues discussed included present and potential catch/effort, vessel maintenance, existing export activity, fishing methods, marine mammals, potential impacts by tourism, as well as future vision and attitude toward the fishery.

3. Rowntree, Tarnas, Hillman, and Gebre traveled to Nora Island by boat. Discussions with fishermen focused on fishery activities, including marine mammal and turtle encounters with fishermen of the island. On the return trip to Dahlak Kebir, Tarnas Hillman, and Gebre snorkeled on a reef area to observe the condition of the reef and tourist diving potential.

4. The Team held evening discussions of the day's activities. At the lodging facility, there was ample opportunity to discuss tourist development with the hotel manager, Timical Bosilius. The "hotel" consisted of the old Russian military quarters and was operated by a Eritrean navy dive team. The navy dive team was in the process of building a new hotel facility on the island.

12 September 1993, Sunday

1. Team members traveled by boat with the navy dive team to a popular reef dive spot. Tarnas, Moussalli, Hillman, Gebre, and others dove on the location with the navy team as guides.

2. Jurick, Tarnas and Hillman toured the new tourist complex which was being built by the navy dive team on Dahlak Kebir.

3. The Team returned to Massawa by boat and found accommodations.

4. The Team held evening discussions and planned further Massawa activities.

13 September 1993, Monday

1. Rowntree, Jurick, and Moussalli meet with S. Etoh, Chief Technical Advisor for the UNDP/FAO Semhar Fisheries Project. The Team was briefed on the planned activities of the Semhar project and associated projects (e.g., the Assab Project add-on to the Semhar Project, the Italian Proposal, the Japanese Proposal, the GEF Project, the Urk Interchurch Project, and others). Among other fishery issues, the following issues were discussed: extension and training programs, marketing, net-building operations, counterpart problems, MMR departmental training needs, stock assessment needs, and the sardine fishery.

2. Tarnas and Hillman met with the Mayor of the Municipality of Massawa, Mussa Naib. The Mayor briefed the team on the history of Massawa and the current situation. Major concerns were water, electricity, sewage, and housing. They are now working on a master plan for Massawa to deal with zoning for industry, housing, and tourism issues. Assistance needs were identified in coastal management related planning issues; UNDP and USAID are considering assistance in this area.

3. Moussalli, Rowntree, and Jurick visited the Massawa ice facility and discussed the operation with the staff on hand. The facility maintenance operator explained the existing ice production system and limitations. He had been trained by the previous private owner and stayed on when the government acquired the facility. This facility was the only source of ice in Massawa. The primary ammonia refrigeration system which also operated the cold storage unit had been damaged during the war, but used antiquated parts and was irreparable. The only ice making capability that existed was a freon block system which produced less than four tons of ice in a 24 hour period. More than half the total production was dedicated to the fishing operations, and the local hospital and restaurants received the rest.

4. Tarnas and Hillman met with the Director of the Port of Massawa, Amare Fitwee. The Port Director briefed the team on port operations and activities. The plan is to reconstruct the port, and assistance looks promising from the Italians, British, Finnish, and Japanese. They need to demolish the old buildings, to asphalt the roads, to dredge the berths before they can expand the port area with more warehousing, a container terminal, possibly form a free trade zone, and expand light industry. Fishing jetties and landings will be outside the commercial harbor area. There will be some cold storage built in the port for fish, vegetables, and fruits. Control of pollution from urban sources was identified as a major problem. Public education is needed. There is also a plan to rebuild the lighthouses and other aids to navigation.

5. The Team traveled to Hargigo, site of the proposed Fishery Training Center as well as the future location for the administrative center for the Ministry of Marine Resources.

6. The Team met to discuss findings and begin formulating potential project needs.

7. Jurick and Moussalli traveled to the Ministry cold storage facility and fish landing site to observe the unloading activities. Two vessels, one which was Yemeni, were unloaded. The Dahlak Cooperative representative was present to oversee the weighing of the catch which was bought by the MMR. The Yemeni vessel's catch was bought by the Red Sea Cooperative. The normal procedure is that a fisher arranges the sale of the fish to one of the cooperatives prior to the fishing trip. Quality control and other fish marketing issues were discussed with various cooperative representatives, the government veterinarian, and MMR representatives during the unloading process. The Dahlak fish were loaded directly on to the MMR refrigerated truck for transportation to Asmara. In addition to the fresh reef fish which were loaded directly on the truck, dressed shark which had been stored in the refrigerated units were loaded last to fill the truck.

8. Rowntree, Moussalli, and Jurick met again that evening with Mr. Etoh to continue earlier discussions. Kifle Woldeselassie, MMR Semhar Project Manager, also was present. Items discussed included monitoring and resource assessment needs, institutional training needs, the Hargigo Marine Training Center, planned fishery extension activities, and the Helva Island ship building facility. Kifle explained the rebuilding plan for Hargigo and stated that the MMR move to the village is not in the immediate future. As facilities become available the move will take place, but the immediate plan is to move the MMR offices to Massawa. Mr. Etoh emphasized the need for in-country training for MMR personnel.

9. Tarnas met with Chris Hillman, Director of MMR Research. The two discussed the MMR marine and coastal research program, literature resources and planned projects. Detailed discussion focused on marine park management, the role of the Eritrean

Diving Association and navy personnel in developing the marine park plan, as well as development of a mooring buoy design appropriate for the Dahlak Islands.

14 September 1993, Tuesday

1. Team members observed the net building operation located on the outskirts of Massawa. Four women were actively building nets which would be sold to local fishermen.

2. Tarnas, Kifle Woldeselassie, and Hillman met with the Deputy Provincial Administrator of the Semhar Province, Zerit Tewoldeberhan. The Administrator explained that the provincial government serves a coordinating role in planning and development processes. At present they were organizing and assessing damage in Massawa and the surrounding areas. There is strong interest in tourism development, but no concrete proposals. He explained that any proposal which dealt with the coast and marine environment would involve the MMR. Any tourism project involves the Tourism Department. If the islands were involved, the MMR, the Department of Tourism, and the Island Administration would be involved. The Administrator emphasized that the people need to benefit once again from the marine resources and any help USAID could offer would be very useful and appreciated.

3. Jurick, Moussalli, and Rowntree met briefly with Mr. Etoh to acquire some information on the Semhar Fishery Project. The group discussed the Women Net Building Program and the sardine resource. Mr. Etoh agreed that the prosperous fish meal operations of the 1960's was no longer a viable opportunity due to changes in the world demand for fish meal products. The possibility of fish silage as a agriculture feed source was discussed at length, and Mr. Etoh explained he had also considered that as a possibility, but had neither the time or money to pursue it.

4. Tarnas and Hillman met with the Supervisor of the Eritrea Cement Plant, Mr. Habtemicael. The supervisor explained that they quarry the raw materials adjacent to the factory which was located on the coast. They mine approximately 8,000 tons per month. The quarry operation has extended to within 10 meters of the shoreline. The primary pollution is from air emissions of dust. They wish to install electrostatic precipitators to reduce pollution, as well as prevent the loss of the dust, which represents 30-40% of the raw material. There is a high demand for cement and they are planning to expand their facility by 40 percent in the next few years. They supply cement to all of Eritrea. The quarry is located directly next to the tourism beach at Ghurguzzum.

5. Rowntree, Moussalli, and Jurick met with Mr. Abdullah, the MMR staff person who purchases dried shark fin, snail nails, and sea cucumber. He explained that the reason that MMR got involved with such purchases was to create a local market for the

products so that fishermen did not have to sell their product cheaply to the traditional Yemen buyers.

6. Tarnas toured the Massawa landfill site, which is located directly on the shoreline and being pushed into the sea. An abattoir, located near the landfill site, was also adjacent to the shoreline and discharged directly into the sea. The proposed site for the fish market is adjacent to the abattoir.

7. Tarnas and Hillman toured the Massawa salt works with the Superintendent, Mr. Mengkisteas. Water quality was checked as the sea water entered the salt ponds. There has been some problem with petroleum contamination at which time the water is rejected. No problem with heavy metals has been identified. The salt water goes through twelve ponds before it finally evaporates, therefore most impurities have settled out. The ponds cover approximately 4,440 hectares, extending all along the coastline for the 11 km stretch from Hargigo to Massawa to Ghurguzzum. They are using 25 percent of the area now and producing 40,000 tons of salt per year; they employ 230 people, 60 of whom are contract laborers. Peak production, under the Italians, was 70,000 to 130,000 tons per year using all the ponds. They are working to rebuild the salt washing facility, packing house, and storage warehouse which was damaged during the war.

8. Team members returned to Asmara by car. During the drive, the group discussed findings and formulated potential project needs.

<u>15 September 1993, Wednesday</u>

1. Team members worked on drafting contributions to the Team report.

2. Rowntree met with the Minister of Marine Resources, Saleh Meky.

3. Jurick met with Johannes Koornstra, Danish Fishery Expert for the Urk Interchurch Project. The Master Fishermen discussed past and future fishing activities which he planned to conduct. He had extensive community-based fishing experience and success working in Ethiopian lakes and Southeast Asian ocean waters. His plans for Eritrea included shifting the net building activities towards net mending activities, since Holland was beginning to export manufactured nets to Eritrea. He explained that those nets which the women were making had a ready market in Ethiopia for the lake fishery with which he was previously associated. Other plans included experimentation with drift gill nets and tuna. Jurick exchanged information on the tuna fishing and reef fishing techniques. The Master Fishermen also planned to investigate a possible Tilapia culture/fishery in ponds around Hargigo. He indicated that Tilapia had been observed and water was present in these ponds year round. The fisherman agreed that a stock survey was necessary which was partially why his

major effort would be to systematically fish the Massawa coastline. He emphasized that the Dutch budget was only three million Guilders and that included all aid to Ethiopia, which left his project very lean and the sale of the fish would subsidize his project activities.

16 September 1993, Thursday

1. Team members met with MMR staff and other ministry and donor representatives to travel by airplane to Assab. Those donor agencies included representatives from USAID (George Jones), UNDP (Michael Askwith), WFP, WHO, and the Ministry of Health.

2. Rowntree, Moussalli, and Jurick toured the MMR Workshop and Coldstores facility. They met with staff and discussed operations and facility development.

3. Jurick and Moussalli viewed local fishing vessel activity along the beach near the MMR facilities.

4. Tarnas met with Mr. Osman Buluh, Mayor of Assab, and Ali Agut, Vice-Mayor of Assab. They had discussions regarding the current status of the town, critical coastal planning issues being faced by the government, planning capabilities of the municipality, and future development plans for the urban area. Issues regarding management of solid waste, sewage, the port, the refinery, and water quality were discussed in detail. The municipality is taking the lead in initiating the redevelopment of a master plan for Assab based on earlier plans done in 1968 and 1985.

5. Rowntree, Moussalli, and Jurick toured the MMR fish market facility.

6. Tarnas met with Mr. Mohamed Said Bare, Governor of Dankalia Province. They discussed issues regarding Assab, current urban and coastal planning problems, and the role of fishing in the community. The Governor emphasized that the urban area has many problems it needs to face: water, sewage, infrastructure, and transportation. But the priority problems are improving the hospital and sending medical care to the outlying villages. The province is working with the municipality on the development of a current master plan for Assab.

7. Rowntree, Moussalli, and Jurick met with a local restaurant operator to discuss the local availability of fish.

8. Tarnas and Rediet met with Mr. Afeworki Tesfazion, Production Manager, Assab Petroleum Refinery. They discussed the current production profile of the refinery, current maintenance, safety and pollution control measures, future development plans and environmental issues. He emphasized that the biggest environmental concerns

are the storage, transfer and shipping of oil, as well as any production of crude oil should that come in the future.

9. Rowntree, Moussalli, and Jurick meet with the manager of the local hotel to discuss the availability of fish. Other topics discussed related to the Eritrean Ministry policy of controlling fish prices, hotel rates, and wages for hotel labor.

10. Team members attended a luncheon banquet, along with the other donor representatives, prepared at the request of the MMR. MMR Representative in Assab, Sheikh Mahmood Ahmed, was our host.

11. Team members, along with the accompanying group, returned to Asmara by plane via a flight path which flew along the Eritrean coastline and out over the Dahlak Islands. The flight path stimulated a great deal of discussion relating to the observed coastal resources.

12. The Team met in the evening to discuss the activities of the day and to begin preparation of the Team's report.

<u>17 September 1993, Friday</u>

1. Team members work on project report.

<u>18 September 1993, Saturday</u>

1. Team members work on project report.

<u>19 September 1993, Sunday</u>

1. Team members work on project report.

2. Rowntree met with George Jones and Dean Alter, USAID/REDSO/Nairobi, to discuss the progress of the Team, USAID directions, and Eritrean coastal and marine resources.

3. Rowntree continued discussions with Dean Alter.

4. Rowntree met with Dean Alter and Reda Erdzy, Eritrean Investment Advisor, to discuss alternative investment prospects.

<u>20 September 1993, Monday</u>

1. Team members work on project report.

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2. Team members meet and discuss findings with Saleh Meky. A full range of issues was discussed, but particular attention was devoted to fisheries stock assessment needs and the need for fisheries regulations, monitoring, and management control measures.

3. Tarnas and Rowntree met with Mr. Haile Woldetinsae, Minister of Finance and Development. They discussed general plans for economic development and highlighted 1) the need for emergency reconstruction and rehabilitation, 2) the need for more information on marine and coastal resources, and 3) the need for building expertise in planning and management in the ministries who work with the local and provincial governments and private sector. To address these needs, the Minister said they are 1) working to rebuild agricultural production and basic infrastructure, 2) developing guidelines for general policy and regulations for environmental protection and economic development, including the National Environmental Action Plan, and 3) developing master plans for development in each sector and across sectors. Discussion also revolved around price control strategies for fish and other commodities and government involvement in basic industries. The Minister said, "Eritrea needs a kind of Marshall Plan." He indicated that assistance from USAID to help address these issues, recognizing the reality of the Eritrean situation, would be useful.

4. Jurick prepared a rough estimate of the possible costs of transporting a Japanese research vessel to Eritrea.

5. Team members continue to work on project report.

6. Jurick met with Glenn Burks, assistant in the Department of Industry, to discuss potential fertilizer needs and production in Eritrea. Topics included the potentials of fish silage as a feed additive and fertilizer.

7. Rowntree met with George Jones to discuss the Team's report and recommendations.

8. Team members met with Dean Alter to discuss possible short-term projects.

<u>21 September 1993, Tuesday</u>

1. Team members continue to work on project report.

2. Tarnas and Moussalli met with Aldo Jacober and Bruno Mereu. Both are Italian architects. Jacober is the lead architect who is volunteering his time, along with a team of thirty architects, designers, and planners, to assist the government of Eritrea address issues regarding urban planning, building codes, and regional development plans. A main focus of these efforts is assisting the Department of Tourism on the

design of a master plan for tourism development, including recommendations regarding coastal tourism and the marine park around the Dahlak Island Archipelago.

22 September 1993, Wednesday

1. Rowntree conducted a formal briefing of USAID (George Jones, Pam Delargy, and others) on the findings and recommendations of the Team.

2. Team members conducted a formal briefing on project findings and recommendations to the Minister and the staff of MMR. The briefing stimulated an open discussion of project recommendations.

23 September 1993, Thursday

1. Team members continue work on final revisions and editing of the draft report.

2. Team members printed a final version of the draft report and made copies for USAID and the MMR.

24 September 1993, Friday

1. Saleh Meky, Kifle Woldeselassie, George Jones, and Joseph O'Neill all extended warm farewells to the Team members as they departed Eritrea on their return flights to the U.S.

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Appendix C. List of Contacts

The following is a list of names and affiliations of individuals contacted by RDA Team members during their conduct of the activity. Apologies are extended to those who were inadvertently left off the list and to those whose names were incorrectly or incompletely recorded.

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Ali Agut
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Appendix E. Results of Workshop

Workshop on the Management of Coastal and Marine Resources for Sustainable Development
September 9, 1993
Asmara, Eritrea

Sponsors:
Eritrea Ministry of Marine Resources,
U.S. Agency for International Development, and
RDA International, Inc.

AGENDA:

I. Introduction
II. Vision Exercise
III. Constraints, Conflicts, and Challenges
IV. Break
V. Eritrean Action Plans
VI. Donor Assistance Programs:
    Current Programs
    Additional Assistance Needed
VII. Closing

I. INTRODUCTION

Kifle Woldeselassie, Ministry of Marine Resources, welcomed all the participants to the workshop on behalf of Dr. Saleh Meky, the Minister who regrettably had to be out of town at this time. Mr. Woldeselassie emphasized the Minister's belief in the need for sustainable development of coastal and marine resources. He expressed the hope that the workshop would be productive and useful for everyone. He welcomed the USAID team and said that the Eritrean government would work to provide whatever information the team needed. He then introduced the USAID team and turned the meeting over to Dr. John Rowntree, the team leader.

Dr. Rowntree thanked Mr. Woldeselassie and the Ministry for their kind welcome. He expressed appreciation that all the participants were able to attend the workshop. He explained that by expressing their views, the participants are helping the team gather information and gain a better understanding of Eritrea's vision of future development of coastal and marine resources. With this information, the team will then provide recommendations to USAID as to potential areas of assistance that would complement existing donor programs and be of use to the Eritrean government. Dr.

Rowntree then introduced David Tarnas who would act as the facilitator for the meeting.

Mr. Tarnas introduced the format of the meeting, the agenda, and the ground rules. In the format for a facilitated workshop, there are two people who work for the participants to assist the group in working through the agreed-upon agenda. The facilitator works to guide and stimulate the group's discussion. The recorder takes notes on a large easel pad that accurately represent people's comments. These notes are then prominently displayed on the wall so the group can refer to them at any point through the meeting. The facilitator helps guide and stimulate discussion by introducing a topic area within the agenda item if the group doesn't do it on their own, such as future fisheries development. He would then ask for comments for individuals and ask questions of clarification so that the notes are accurate. After covering that topic area completely, getting all the comments the participants have, then the facilitator would then turn to the next topic. In this way, the comments are grouped, though not necessarily prioritized.

Everyone then introduced themselves and explained the department or ministry which they represent. Eight different institutions were represented by a total of sixteen people, in addition to the four resource people from RDA, International, Inc./USAID.

Mr. Tarnas, the facilitator, expressed the desire to have everyone's participation in the meeting, because every idea is useful, and discussion helps to bring about a better understanding of such a complex topic as sustainable development of coastal and marine resources. With that, the group began the vision exercise.

II. **VISION EXERCISE:** What is your vision of the future sustainable development of Eritrea's coastal and marine resources?

Planning and economic development

- Achieve food self-sufficiency (including fish).
- Course of development must be planned.
- Develop comprehensive and integrated program for economic development.
- Develop master plan for all aspects of development.
- Expand employment.
- Develop manpower and information.
- Provide raw materials for local industries.

Fisheries Sector Development and Resource Management

- Expand fish exports to get foreign exchange.
- Expand transportation, raw materials, fish, and agricultural product processing facilities.
- Expand fish and salt production and processing facilities.
- Develop a marketing system for fish.

Coastal Resources Management and Environmental Concerns

Preserve the environment.
Need sustainable and balanced development of all sectors in coastal areas.
Coordinated tourism development while protecting environment.

Energy

Provide energy for coastal development.
Develop renewable energy sources (wind and solar) for refrigeration.
Extend energy to remote areas.
Develop energy for industry expansion to overcome main constraint (geothermal, wind, solar, etc...).

Agriculture

Develop water resources (desalination).
Restoring degraded areas.
Develop agriculture in coastal lowlands, build supporting dams, etc. for irrigation.
Expand vegetable and oil crops in the coastal lowlands.

III. CONSTRAINTS, CONFLICTS, AND CHALLENGES

Constraints

Planning and Economic Development

Main constraint is lack of financial resources.
Housing facilities and other incentives for hiring returning Eritreans who are trained, and trained Eritreans who are living abroad.
Lack of awareness of public/private conflicts.

Fisheries sector development and resource management

Need for information and data on fisheries - what are our resources? where are they? How much resources are there? We need to do a stock assessment!
Lack of trained manpower in fisheries and other areas.
Lack of infrastructure (boats, port facilities including jetties and landing facilities, cold storage, transportation, and marketing facilities) in fisheries.
Low institutional capacity in government and industry (in fisheries) - need to improve planning ability.
Low production capacity in fisheries.

Coastal resources management and environmental concerns

Lack of awareness of marine pollution.
Lack of means to prevent pollution from passing ships.
Lack of port facilities to deal with ship discharges.

Energy

Lack of Energy

Conflicts

Planning and Economic Development

Avoid pollution from urban expansion.

Need to balance industry, agriculture, tourism, and fishery development.

Fisheries sector development and resource management

Conflict between artisinal and industrial fishing.

Conflict between local fishermen using gill nets in shallower waters and the large trawlers targeting shrimp in the same areas.

Resolve conflicts between need for marine parks and for fishing (conservation vs. development).

Coastal resources management and environmental concerns

Prevent tourism development from adversely affecting marine resources and fishery development.

Energy

Need to do oil and gas exploration in a way that protects environment.

To utilize geothermal resources in environmentally sensitive way and to use it directly (as heat) and indirectly (as electricity).

Challenges

Planning and Economic Development

Government/ministry planning and coordination before adverse effects occur.

Need to set priorities for various developments (type and timing).

Local people should also gain from investment and industrial expansion.

Fisheries sector development and resource management

Marketing for fish.

Educate people in preparing fish to encourage fish consumption.

Need to increase fish availability.

Training for fishermen in modern techniques.

Need to upgrade education and general living standards of fishing communities.

Coastal resources management and environmental concerns

Expand knowledge of coastal areas - identify fishing areas, diving areas, tourism areas, marine parks, energy infrastructure, agriculture areas, industry areas - so a master plan can be developed (using zonation systems).

Marine park needs to be planned.

Need to develop strategy by including views from the people - encourage popular participation in building development strategy for coastal tourism and fisheries.

Using traditional activities in coastal tourism activities.

IV. BREAK

V. ERITREAN ACTION PLANS: What are Eritrean government agencies doing to address this vision and to meet these challenges?

Planning and Economic Development

Developing capacities of various agencies.

Initiating discussions among ministries as prelude to the development of a tourism master plan.

Fisheries sector development and resource management

Fisheries: drafted fisheries legislation - goal of stock assessment. 1st priority is artisinal fish. 2nd priority is industrial fisheries.

Women are involved in fishing already, there is a training program in which eight women are being taught net making.

Coastal resources management and environmental concerns

Marine Resources Environmental Action Plan - marine parks.

Coastal tourism: involving local people.

Energy

Energy: improving generating capacity.

Energy: Diversifying energy consumption - promoting solar, collecting solar and wind data, trying to reduce consumption of biomass.

Energy: Long range - improve grid system, standardizing appliance requirements, preparing conservation education program.

Agriculture

Agriculture Development Strategy: 1st phase - rebuilding base, reconstruction, distributing seeds, etc.... 2nd phase - construction/irrigation/expand land cultivation. 3rd phase - build larger dams/more irrigation/further land cultivation.

Tourism

Tourism: training courses for tourism workers. Catering institute. Other training programs are also established, such as through women's organizations, developing skills that are marketable, i.e., handicrafts.

Ports

Plan for developing and expanding ports and maritime fleet, and harbor masters.

Investigating joining international conventions and organizations, such as the International Maritime Organization.

VI. CURRENT DONOR ASSISTANCE ACTIVITIES

Planning and Economic Development

Investments: United Nations TCMD (Trade Cooperation Management Development) Aid to Investment Center to redraft the Investment Code, and provide assistance in coordination among ministries in economic development planning.

Fisheries sector development and resource management

Fisheries: FAO/Technical Cooperation Program (TCP) Project (fisheries legislation, fisheries sector assessment, study of coastal areas). UNDP Project - Semhar project - fisheries development training (including Assab Project that is just getting started.

Fisheries: Several proposals: Italian project to fund 30 boats, some trucks, and development of market outlets in 6 towns. Another is the ODA proposal for a training center.

Fisheries: NGO projects underway: Urk Interchurch project to train 35 men in fishing and 8 women in net making. A private Italian volunteer project to train Scuba divers. PROFERI project for assistance in relocation of refugees. Manzanar project (mangrove/aquaculture/farming integrated system) has initial funding.

Coastal resources management and environmental concerns

GEF (Global Environment Facility) project looks promising - it will do a baseline inventory of marine and coastal environment.

Energy

NGO assistance in solar cooking activities.

Agriculture

Agriculture: There are many NGO (nongovernmental organization) projects that funds seeds, draft animals, tractor, other machinery for dam construction, terracing for conservation, farmer training, and reforestation. There is a proposal for water diversion funding, but not yet funded. All external aid is supplemented by local funds.

Tourism

Tourism master plan proposals but no project assistance as yet.

Ports

No approved projects. There is a proposal by the Italians to assist redevelopment of the Massawa port.

ADDITIONAL DONOR ASSISTANCE NEEDED

Fisheries sector development and resource management

Fisheries: Stock assessment

Training center to train manpower in refrigeration, fish processing, navigation, boat handling, fishing, trainers and extension officers.

Training in boat building and repair (partially addressed by Semhar project).

Inland fisheries: develop reservoirs for aquaculture.

Introduce fish in diet through consumer education. Introduce it in schools.

Projects focusing on women:

- expand net making training
- shell industry training
- training in fish processing plants.
- nutrition and fish preparation training

Utilizing fish waste in feeds, etc...

Coastal resources management planning

Assistance in developing tourism master plan. This includes tourism planners, marine park and conservation planning, developing regulations for various types of tourism construction, and environmental protection regulations.

Coastal management to assist town planners and marine park planners.

Training for officers to enforce regulations on foreign fishermen and to protect the environment. This includes training and provision of equipment.

Energy

Energy: using energy production facilities to produce fresh water.

Use geothermal energy heat resource in fish processing, solar energy in refrigeration and air conditioning, and wind power in coastal areas.

Agriculture

Projects focusing on women:

train qualified nutritionists

Tourism

Funding for catering center.

Projects focusing on women:

catering training, also for other tourism services such as managers, receptionists, etc...

Ports

Short term: training abroad.

Long term: develop a training center. Also need to update maritime legislation, port facilities for handling ship discharges (in order to sign MARPOL - an IMO team of consultants is coming to assess this). There is a desire to expand and develop ports and the merchant fleet.

Salt works:

Salt works in the coastal area: train people in expanding the salt works processing and export, train them for management.

VII. CLOSING

In discussion of general priorities, it was clear that information needs for fisheries and marine resources management were very high. Also at the top of people's agendas was the need to develop master plans to coordinate and integrate the management of coastal development and resource use. It was noted that in both areas of fisheries/marine resources information projects and coastal resources planning, technical assistance is needed, and should be done in cooperation with local experts, so they can learn more while working together with the foreign expert. Training through working with foreign experts, and training while on the job is most effective. The overall lack of financial resources necessitates that donors assist in financing these programs for gathering and analyzing information for fisheries and marine resources management, and programs in coastal resources management planning, along with the training of local staff in both areas.

Mr. Tarnas thanked the group for a very productive session and turned the meeting over to Dr. Rowntree who explained the next steps for the team. The team will take this information and analyze it, attempt to devise recommendations based on this and further research as to useful and appropriate assistance programs. The team is going

to Massawa for five days and would return to Asmara for another ten days. He encouraged any further participation and input from the participants at any time. The team could be contacted through the Ministry of Marine Resources. He thanked the participants for their great effort and substantial information provided to the team. He expressed the hope that team would carry out a successful mission. With that, he turned the meeting over to the host representative, Mr. Woldeselassie, who thanked the team and the participants for a stimulating and productive discussion. He said that the Eritrean government would try to help the team in whatever way they could. He then closed the workshop.

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